VOLUME II — PHILOSOPHICAL STUDIES
OF
THE AMERICAN CATHOLIC PHILOSOPHICAL ASSOCIATION

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A Study of Saint Thomas' Commentary on the Eight Books of Aristotle's Physics

BY
JAMES A. McWILLIAMS, S.J.
Professor of Philosophy, St. Louis University

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Price $2.00

Nihil Obstat:

CHARLES A. HART
Censor Deputatus

Imprimatur:

✠ MICHAEL J. CURLEY
Archbishop of Baltimore and Washington

November 16, 1945

INTRODUCTION

In addition to its official quarterly journal of philosophy, *New Scholasticism*, and its annual *Proceedings*, the American Catholic Philosophical Association has also established its *Philosophical Studies*, of which the present monograph, *Physics and Philosophy*, a *Study of St. Thomas' Commentary on the Eight Books of Aristotle's Physics*, by Rev. James A. McWilliams, S.J., is the second volume to appear. The primary purpose of the *Studies* is to encourage research in the field of philosophy by providing publication for noteworthy studies, particularly if they might otherwise not be published by commercial concerns. The Association's present Committee on Research, Professor Vernon Bourke, acting Chairman, Dr. Celestine Bittle, and Dr. Miriam T. Rooney, recommended publication of this second volume even though it is not an original research because the Committee felt this study of a difficult and little known, but nevertheless important, work of St. Thomas Aquinas, would be of definite service to the membership of the Association and other students of St. Thomas. The volume is therefore an instrument for further research rather than a research itself. As Doctor McWilliams rightly observes, a true comprehension of the whole philosophy of St. Thomas as a system cannot neglect his *Commentary on the Physics of Aristotle.* Yet its difficulty has made it perhaps the least known of what is now recognized as a major Thomistic work, hence the value of this study which, incidentally, has had the advantage of proving itself by its use in mimeograph form by advanced students in philosophy at St. Louis University over a number of years. For the Association the Executive Council desires to express its appreciation of Dr. McWilliams' offering of his excellent handbook to become an addition to its *Philosophical Studies* series. He has thereby rendered a distinct service to all lovers of the wisdom of the greatest of the Christian philosophers whose lofty speculation transcends all time and is therefore always contemporary.

CHARLES A. HART, *Secretary*
American Catholic Philosophical Association.
Editor, *Philosophical Studies*

CATHOLIC UNIVERSITY OF AMERICA,
WASHINGTON, D. C.

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I

FOREWORD

ST. THOMAS'S *Commentary on the Eight Books of Aristotle's Physics* has long been considered one of the most difficult products of his pen. Yet, that the full tenor and force of the rest of his writings cannot be satisfactorily grasped without an adequate understanding of the *Physics*, has been the perennial conviction of Thomistic scholars. The original texts of Aristotle and his various commentators are rather baffling. And though St. Thomas's *Commentary* is the most lucid of all, any one who has undertaken to study it does not need to be told that it is an arduous and exacting task. The consequence is that St. Thomas's *Physics*, despite its importance, has remained for most students pretty much of a "closed book."

In order therefore to help toward a better comprehension of the entire Thomistic philosophy, I have proposed in Part Two of the present work to do two things. I have undertaken to cull from the full text all the essential doctrines and arguments that are necessary to a satisfactory understanding of many important passages in the other works of the Angelic Doctor. At the same time I have endeavored to record each item and link required for the integrity of the *Physics* itself. To achieve this twofold purpose, special problems, of which the discussion is often lengthy and set forth by means of letters (A, B, C, etc.), are reduced to the simplest possible statement. Again, St. Thomas, in his endeavor to give the true interpretation of Aristotle, as well as to remedy an occasional error or deficiency, often finds himself at odds with previous commentators, especially Avicenna and Averroes. While these discussions are very enlightening as erudition, and of great interest to specialists, who will naturally consult the original text, the purpose of the present work has permitted little more than the recording of St. Thomas's conclusions. For the same reason repetitions or resumés of previous expositions are indicated by references to earlier passages. Certain doctrines, as those concerning substantial change, prime matter, creation from eternity, have, because of their importance, been transcribed at greater length or quoted verbatim, a complete rendition of the first five *Lectiones* of Book Three,

the heart of the *Physics*, is supplied and a note on the sempiternity of the world is given as an appendix. Finally, the Analysis of the 8 Books and the list of references to the *Summa Theologica* and the *Summa Contra Gentes*, both of which exist in English translation, will, it is hoped be an aid to all students of St. Thomas.

It used to be mistakenly thought that St. Thomas's *Physics* was one of his earlier and " immature " works. Recent scholarship however has placed the date of its composition rather late in his life, ranking it with the most mature products of his genius. Thus Mandonnet, in his *Bibliographie Thomiste* (Introd., p. xii) gives its date as about 1265. Grabmann, in his *Die Werke des hl. Thomas von Aquin* puts it in the year 1268 (Cf. BGPM xxii; Munster, 1931; p. 262). And I am reliably informed that on the evidence of more recent research it may even post-date 1270. All this enhances the importance of the *Physics*.

There is of course no question that the work is authentic. Latin editions are found in the *Piana* (vol. ii), *Parma* (vol. xviii), *Vivès* (vol. xxii), and a critical text is available in the *Leonine* Edition (vol. ii). But there is no translation of the entire text in any modern language. Nor is there likely to be any such translation in the near future. In any case, there is such a welter of outmoded physical hypotheses and philosophical interpretations of them, that an indiscriminate presentation of them all, while of great interest to the historian, cannot appreciably relieve the labor of the student who is bent on a mastery of the significant content of the *Physics*. It is with the hope of mitigating that labor that these pages are offered to the students of St. Thomas. Certainly, where the discussion is on the purely philosophical plane, independent of variant formulations of physical laws, a full translation cannot fail to be helpful to all types of readers. Such discussions are scattered through the entire work, and I have tried to give the gist of them in the extracts and summaries which make up the Second Part of this study. The longest and most essential of these purely philosophical passages is the first half of Book Three. For that reason it is given herewith in full translation, with appropriate headings to clarify the otherwise rather confusing text. Undoubtedly, there will be students who wish to go further than the present work will take them, but even for them it should prove to be a helpful introduction.

PART ONE

SETTING OF THE PHYSICS

II

INTRODUCTION

The Astronomy of the Physics

THE greater part of the *Physics* is unintelligible without a knowledge of the system of astronomy on which the explanation of natural processes, or *motus*, is based. This system Aristotle adopted from Eudoxus and Callipus, with some modifications of his own. The important point in which it differs from our present-day system is that it is geo-centric; ours is not. The Earth, while conceded to be spherical, was regarded as stationary in the center of the universe. The oft-repeated assertion that the ancients considered the Earth as "flat" is nonsense. Nor is it true that the idea of the Earth turning on its axis is in any sense modern; that idea is almost as old as astronomy itself. Why, then, you may ask, did not the ancient astronomers adopt the idea and thus solve the problem of the motion of the heavens? The answer is that the mere revolution of the Earth does *not* solve the problem. The problem was finally solved by Copernicus, who advanced an entirely new idea, never entertained before—the orbital motion of the Earth (and the other planets) around the Sun.

School children are now familiar with this explanation. Yet despite the explanation, all the heavenly bodies, except the fixed stars, still *appear* to us to move with the same erratic motions which baffled the ancients. Knowing the explanation, we now call them "apparent motions." Since Copernicus's time astronomers are aware that the platform from which they make their observations, the Earth, is itself moving in an orbit; and so they are able to explain the apparent motions of the heavenly bodies.

Prior to Copernicus, astronomy was extremely complicated. Aristotle, unable to do anything else, had to take it as he found it. St. Thomas, indeed, had the advantage of Ptolemy's *Almagest* and still later observations. Perhaps the most notable of these observations is revealed in St. Thomas's statement that the very celestial pole itself, centered near the North Star, describes an

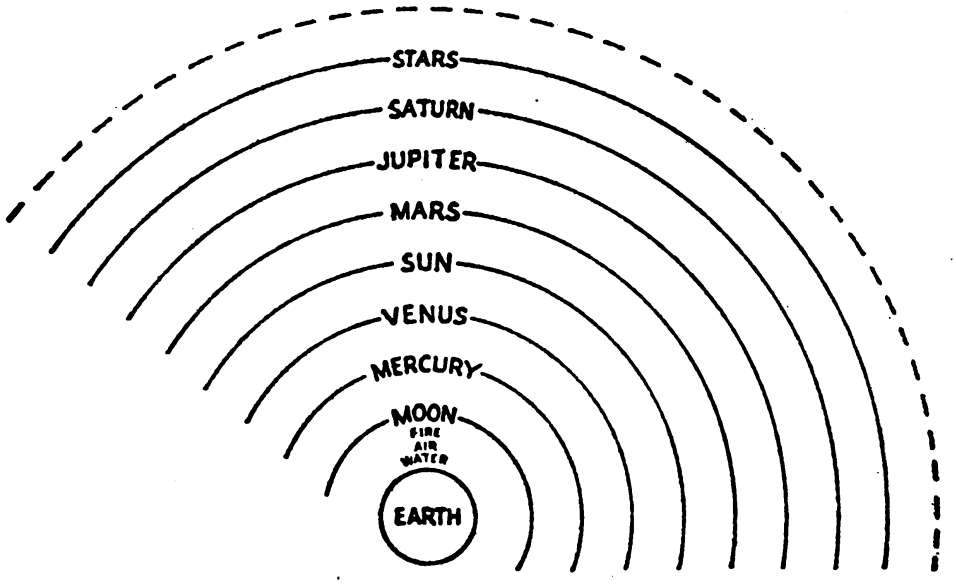
orbit every "36,000 years" (Cf. *Physics*, Bk. viii, L. 23). Although the present calculation is nearer to 26,000, it is enlightening to learn that St. Thomas was aware of the phenomenon. Yet for the most part, he, too, though he complained of its intricacy, had to take astronomy as it was presented to him by the science of his day.

The accepted picture of the universe was that of concentric spheres, of which the common center was the Earth. All, except the Earth, were hollow spheres, and were transparent save at the spots where the heavenly bodies, which moved with the spheres, were embedded in these crystalline shells. Aristotle was the first to maintain that the celestial substance (spheres and bodies both) was of a different sort from all sublunary substances. These last named were the four elements and compounds of the same. The celestial substance was a fifth kind, and so was called "quintessence"; it did not undergo any change except the motion of revolving about the Earth.

It is important to remember that the energy required for sublunary processes was considered to be transmitted from the outermost sphere down through the others to the region of change. St. Thomas however mentions radiation of the Sun and other heavenly bodies as an additional source of energy. But, aside from that, all material energy originated in the revolution of the outermost sphere (actuated by an "intelligence") and was communicated by contact with the next lower sphere, and so on down to that of the Moon. The difficulty with this scheme was that it would seem to result in all the spheres revolving with the same period of rotation. That was contrary to fact; the lower spheres lag back and do not keep pace with the fixed stars nor with one another. Hence astronomers postulated other "re-agent" or "buffer" spheres with a slow retograde motion; there being a "re-agent" sphere between each pair of main spheres. Nor was this enough. Still other spheres were needed to account for further erratic motion of the "wanderers"—which is what the term *planets* means. The total number of spheres came to 55 (Cf. Ross, *Aristotle*, pp. 96-98).

The region below the Moon was divided into four levels, each level being the natural habitat of one of the four elements. The accompanying chart shows the main spheres as pictured by the ancients. Naturally, only those planets are given which were known before the invention of the telescope.

THE UNIVERSE OF ARISTOTLE (who followed Calippus and Eudoxus)



Note.—A ninth sphere, indicated by dots, was supposed by St. Thomas (*Physics*, VIII, 23; *Metaph.*, XII, 9) because the celestial pole was discovered to be describing an orbit every "36,000 years." (The present calculation is 25,800.) To modern astronomers, this means that the Earth's axis, like that of a spinning top, is describing this very slow orbit. But in ancient astronomy, with a stationary Earth, it meant that the entire sphere of the Fixed Stars was swaying in that manner. Hence astronomers postulated an additional sphere, devoid of stars, to explain the motion.

PHYSICAL THEORIES

With the advantage of the intervening centuries and the many commentaries that had preceded his, and with a more reliable text before him than others had had, St. Thomas was able to give us a Peripatetic philosophy of nature that is integral and sound. A man of lesser analytic and synthetic genius could not have done so. Realizing that the philosophy was embodied in the astronomical and physical science which Aristotle accepted, he let as much of that science stand as possible, lest the philosophy itself be obscured by disturbing its material framework. In order therefore to understand Aquinas's *Commentary* we must keep in mind the physical doctrines which are the embodiment and exemplification of the metaphysical principles discussed.

The key doctrines, or physical laws, accepted in the *Physics* are mainly the following.

Elements. The four elements (earth, water, air, fire) gravitate, up or down, each to its proper region. They may be forced out of that region, but they return to it when released. Again, when an element is produced, "generated," outside its own region it immediately gravitates thereto.

Organisms. Organic bodies are compounds of the four elements and are heavy or light according to the ratio of compositions, but in their vital operations they move toward their objects according to the way their appetites, "*passiones*," are affected by their surroundings. These movements of the elements and organisms are *natural* motions. *Compulsory*, "violent," motion is produced by an extrinsic agent (free or unfree); and is either against, or in addition to, or without, any natural inclination of the body that is being moved. An example of violent motion is the throwing of a stone.

Velocity, in natural motion, following the rule of all attraction (gravitational, etc.), increases as the body nears its goal. In compulsory motion, after the propellant is withdrawn, the velocity decreases. This is because of the resistance of the medium or the action of a counter force, as gravitation. Theoretically, in the absence of either of these retarding factors, the body would continue in motion indefinitely at a constant velocity. These laws of velocity we still accept today.

Disorder

Nature is not a smoothly working machine. As both scientist and philosopher are aware, there is a certain amount of confusion in the processes of nature. That is because of (1) the fact that natural objects, each bent on its own immediate end, often work at cross purposes; and because of (2) the arbitrary interference of man. This gives rise to the phenomenon of "chance" or "fortune." The former term is applied by St. Thomas to the irrational order, the latter to human affairs; and he shows that they may both be subsumed under an over-all providence of God (Cf. "Causality in the Philosophy of Nature," *Modern Schoolman*, Jan., 1942).

Change

The immediate *subjects* in which change occurs are found in only four of the ten Categories: substance, quantity, quality, place. (The reason why change is not assigned directly to the category 'relation,' is explained in Book Five, Lectio 3.) Substantial change is the change from one species of substance to another. Either it is from a given substantial form to the privation thereof, which is called "corruption," as the death of an organism; or it is the change from the privation of a form to its acquisition, which is "generation." This occurs, for instance, in the conversion of nutriment into living tissue. Quantitative change is either "augmentation," as the increase from the size of water to that of "air"; or it is "diminution," the change in the opposite direction, as when "air", that is steam, is converted into water. Qualitative change is between two contrary qualities, or between a given quality and the simple privation thereof; as when white changes to black, or to colorless. Local change is any motion from one place to another. In the inorganic world, "natural" local motions are either rectilinear, as the motion of the elements up or down, according to the centrifugal or centripetal force; or circular, as the motion of the spheres.

Changes in quantity, quality and place are continuous changes, and are therefore in the strict sense *motus*. But with regard to substantial change a distinction must be made. Substantial change "simpliciter" is nothing more or less than the advent of the new specific nature. This change is timeless, "instantaneous," and is therefore not *motus*. And the new nature endures without variation of species, for any length of time, until "corruption" ensues. But it must be remembered that, prior to substantial change "simpliciter," there is always an "alteration" of qualities, or "dispositions," preparatory to the advent of the new substantial form. This preparatory procecss, called generation or corruption "secundum quid" ("with reservation"), is continuous over some finite stretch of time and is therefore *motus* (Cf. "Are Substantial Changes Instantaneous?", *The New Scholasticism*, July, 1940).

The Infinite

The following diagram is intended to clarify the use of the term "infinite," and to show how matter, motion and God can, in their proper senses, be called "infinite."

INFINITES AND FINITES

Infinites

"Infinitum secundum quid" (*S. T.*, I, 54, 2; III, 10, 3, ad. 2)

I. "*Infinitum materiale*" (*S. T.*, III, 86, 2, ad 1) or "*infinitum privative*" (*S. T.*, III, 10, 3, ad 1). This "infinite" denotes *imperfection.* There are six instances:
   (a) Prime matter, as "unterminated," un-finited, by substantial form (*S. T.*, I, 7, 1, ad 2), and as capable of augmentation and diminution (*Comp. Theol.*, 18).
   (b) Second matter, as indefinitely divisible (Arist., *Phys.*, III, 1, 207[a] 23).
   (c) Number, i. e. multitude (*S. T.*, I, 7, 4).
   (d) Extent, i. e. magnitude (St. Thomas, *Phys.*, I, L. 15).
   (e) Motion and time (Arist., *Phys.*, III, 1, 202[b] 30).
   (f) Aevum, i. e. the duration of created spirits, as measured by time (*S. T.*, I, 10, 5, ad 4).

II. "*Infinitum formale*" (*S. T.*, III, 86, 2, ad 1) or "*infinitum negative*" (*S. T.*, III, 10, 3, ad 1). This infinite denotes *perfection.* There are two instances:
   (a) The unlimited scope of the created intellect and will (*C. G.*, I, 43, # 10).

"Infinitum simpliciter" (*S. T.*, I, 54, 2; III, 10, 3, ad. 2)

(b) God's infinity: in essence, intellect and power (*S. T.*, I, 7, 1).

Finites (i. e. actually finited)

1. *Matter*, "terminated" by form, either substantial (as soul) or accidental (as shape) (*S. T.*, I, 7, 3).
2. *Motion*, terminated by a stop (St. Thomas, *Phys.*, III, L. 2).
3. *Form*, substantial or accidental, "terminated" by matter (*S. T.*, I, 7, 1).
4. *Existence*, "terminated" by genus, species, subject (S. T., I, 7, 2; I, 7, 3; I, 54, 2; III, 10, 3, ad 2).

Scarcely anything in the writings of St. Thomas has proved so confusing to students as his use of the term "infinite." To overcome this difficulty, it is well to start with the continuum. There are two continua: extension and motion. A continuum is subject to indefinite, or "infinite," division. Now the division of an extensive continuum tends toward the "infinitely" small, the mathematical "infinitesimals." On the other hand, local motion in a given direction tends to the "infinitely" great, the mathematical "infinite." Both of these phases of the "infinite" are taken account of in the *Physics*.

But for Aristotle and St. Thomas, there was yet another "infinite" in things material. They, with all the ancient Peripatetics, accepted the thesis that in the transmutation of elements, the same matter, without addition from outside, and without developing any interstices or pores, passed from the smaller size, say, of water to the larger size of steam; and back again to the size of water. Thus the quantity, the size, was determined by the substantial form. Consequently, matter was of itself quantitatively indeterminate, or "infinite." It had to be limited, or "finited," that is, made finite by the form.

The Significance of St. Thomas's Commentary

Physics, as the term is understood today, is a coordinated system of physical laws. And a physical law is simply a statement of the uniform structures and activities of natural objects. The improved technique of experiment and observation, together with the employment of algebraic symbols, has enabled modern scientists to give their laws a far greater refinement than the crude and often mistaken formulations achieved by their ancient predecessors. But with all their refinement, physical laws are no more than factual, descriptive statements of uniformity; they give no *reason* for the uniformity. Aristotle and St. Thomas were not satisfied with this positivistic attitude toward physical phenomena. *Physics* they understood to be a part of the philosophy of nature, and so they sought to *explain* the phenomena, especially the all-pervading phenomena of uniformity. They attributed this uniformity to *formal* and *final* causes. In doing so they were far from putting a quietus on research, as has so often been asserted; they were identifying two of the immediate principles upon which all physical sciences must rest. Such prin-

ciples, though now cautiously called " presuppositions," have once more in our day become the quest of the more inquiring scientific minds.

Nor is it true that St. Thomas " slavishly " follows Aristotle. Both of them accepted the formulations of physical laws that were current in their times; if there was any slavishness it is to be found there. But we do the same today. However, St. Thomas does not naively copy his predecessor. Not only does he give the very physical doctrines themselves a clarity and precision they lack in the text of the Philosopher; he does the same with the more recondite philosophical reasoning. Thus, in the face of all the previous commentators, he stoutly maintains that Aristotle regarded the material world as created (Cf. Bk. viii, L. 3). He argues that the Philosopher, although convinced that the world must have existed from eternity, was equally convinced that it is, in its very substance, a thing produced. And while he does not attempt to refute the possibility of creation from eternity, he boldly charges Aristotle with bad logic in contending that the world *must* have existed from eternity (Cf. Bk. viii, L. 2). It is true, too, that, like Aristotle, he starts with induction, but he far surpasses him in faithful adherence to the experienced, existential world as his warrant and guide for the conclusions arrived at. In short, he so clarifies, corrects and completes the Peripatetic *Physics*, that, after Aquinas, so long as the ancient scientific framework stood, Aristotle never had need of any other commentator.

III

THE LAWS OF MOTION *

I

ARISTOTLE'S doctrine on motion cannot be understood apart from his view that (a) the sublunary world (the Earth and its atmosphere) was stationary, and (b) all the changes therein were effected through the energy supplied by the outer spheres. The sphere *ran* the world. Sublunary locomotion, increment, alteration, generation, all required not only the radiation of the heavenly bodies, especially of the Sun (*S. T.*, I, 103, 5, ad 1; I, 104, 2) but their *motion* as well. Nor were the "intelligences" turning the spheres in an effort to reach God themselves, but in order to produce on Earth the conditions necessary for human life, in order that *man* might attain to God (St. Th., *Phys.*, VIII, Lect. 14, n. 5; *C. G.*, III, 23, n. 5). As the first principles or prime sources of knowledge were said to be "perfect," so the motion of the spheres was, in the physical order, the prime source of all other movement, and so was called "perfect" (*S. T.*, II-II, 180, 6). In our day we look for energy in chemical forces but we still admit the need of the Sun's radiation.

In like manner, though we moderns still retain the phantasm of a stationary Earth, we intellectually accept Copernicus' statement to the contrary. That statement, for which St. Thomas sighed (*S. T.*, I, 32, 1, ad 2; II *De Coelo*, I, 17) is preferred not because it is more *true* but because, as Dotterer says (*Philosophy by Way of the Sciences*, p. 267), it simplifies astronomy. The most common objection however to Aristotle's theory is not that the heavens move but that they needed to be *pushed*. This objection ignores the fact that the spheres had to overcome *resistance*, and for that reason needed an outside force to keep them going. There is no intimation that they needed such force simply

* The contents of this chapter, in part, have been previously published in two articles in *The New Scholasticism*, and are here reproduced with permission. Cf. Vol. XVI, n. 3; XVII, n. 4.

to revolve. First of all, the retarded motion of the planets, Sun and Moon required Aristotle to introduce between these spheres other " re-agent " spheres (according to the astronomy of his day) as resisting forces, lest all the spheres revolve with the same angular velocity as the outermost sphere. And while the elements moved naturally (upward or downward) by gravitation or attraction to their proper region, still they so moved only after being generated outside that region. Now generation involves corruption, and things *resist* corruption (*S. T.*, I-II, 113, 7); hence extrinsic force was needed for even the motion of the elements. That these bodies increased their velocity as they neared their goal is in accord with the law of attraction accepted today. Aristotle also noted that, due to the resistance of the medium, the larger quantities move faster than the smaller. Thus tiny raindrops (or oil droplets) fall more slowly than large ones, larger bubbles rise faster in water than minute ones. But he did not say that the rate increases *equally* with the size.

That compulsory, or " violent," motion encounters resistance is clear (C. G., III, 23 ad fin.; *S. T.*, I-II, 113, 7). For that reason compulsory motion is always subject to deceleration (Arist., *Phys.*, II, 6, $228^{a}22$). Thus a missile, as a stone thrown in any direction above the horizontal, meets resistance from gravitation in its upward flight and throughout it course encounters resistance from the air. Aristotle's doctrine on projectiles is best summarized in a generally unnoticed passage: *Phys.*, VIII, 10, $266^{b}25$ (cf. St. Th., *Phys.*, VIII, Lect. 22). Aristotle *rejects* the theory that the thrower simply moves the air, which in turn continues to move the stone; because then the air would stop the moment the thrower stopped and all would come to rest at once. He argues that the thrower must impart a " motive force " to the air and that this force is passed on (in diminishing quantities) to successive portions of the air until exhausted. Although this may sound puerile to modern ears it deserves close examination. Certainly the air closing in back of the projectile is an important factor, as the designers of stream-lined cars well know. This is taken into account by Aristotle; he calls it " antiperistasis." But he argues that this is not sufficient to explain the motion of the projectile; there must be a dynamic factor, which in our terminology is momentum. And though he ascribes this partly to the air he nevertheless indicates that at

the end of its flight the stone itself has the momentum by which it moves an object which it strikes. In St. Thomas' words, " The stone makes something else move just as the thrower made *it* move." The last quantity of energy is in the stone itself and is spent on the resistance of the object struck. Here we have our whole doctrine of momentum and inertia.

Aside from this passage there is hardly any explicit reference to the inertia of a body *at rest*—that is, inertia as something distinct from friction or the resistance of the medium. Yet, theoretically, rest was for Aristotle an *actus completus*, a form; and forms resisted expulsion. That resistance would in this case be what we describe as inertia. Experimentally, Aristotle was surely aware that more effort is required to accelerate a body rapidly from a position of rest than to keep it moving at uniform velocity. In fact, that this phenomenon was discussed appears from the *Mechanica* (intended to complete the *Physics*), where we read: " Why is it that a body which is already in motion is easier to move than one which is at rest? For example, a wagon which is in motion can be propelled more quickly than one which has to be started " (Ch. 31, 858^{a}3). And since the medium offers *less* resistance at low speed than at high, the inertia of the body itself must be considered a resistant factor independent of the medium.

Let us now turn to motion in a vacuum. Aristotle's antipathy to " the void " is well known, and his lone witticism was indulged in on the question: " The so-called vacuum will be found to be vacuous " (*Phys.*, IV, 8, 216^{a}27). But he rejected a vacuum because of his restricted definition of " place," and only *within* the universe. By holding a universe finite in extent he admitted empty space beyond it, conceding thereby that the universe could not be said to be in a place—except, as St. Thomas explains, " aptitudinally " (*De Trin.*, IV, a. 3). But in *Physics*, IV, 8, Aristotle discusses at length the question of motion in a vacuum.

In this famous passage he supposes the body to be moving under the influence of a constant force (as gravitation), and begins by noting the observed fact that denser (heavier) bodies fall faster through a given *medium* than the more rarefied (lighter). Galileo is only playing to the galleries when he pretends that the musket ball and cannon ball are substances of different densities; both being lead, both have the same specific

gravity (*Dialogues Concerning Two New Sciences*, I, p. 61, [106]).[1] It is to be doubted whether Galileo ever performed this celebrated experiment at the Tower of Pisa. In any case, to observe the rate of fall through the medium (air) he should have tried a cork ball of the same size as the cannon ball. Besides, Aristotle's statement is that the *same* body will fall faster through a rarer medium than through a denser one, faster in air than in water. And the ratio of two to one which he suggests is not intended as a statement of fact but a mere convenience. To interpret this assertion to mean that in the *same* medium a hundred-pound weight will fall a hundred times as fast as a one-pound weight is a travesty on the text. Countless authors who have repeated this gross canard gave evidence of poor scholarship.

Having discussed the retarding effect of different media on the same body moving under a constant force, Aristotle then asks: What will be the velocity if there is *no* medium? a vacuum? The answer is that since there is zero resistance from the vacuum, all bodies will fall with the same velocity, which will eventually become incomparable to any finite velocity. This is the only answer that can be given, and it effectively refutes the contention of Democritus that in the void, although the atoms had been falling for an eternity they still had finite velocities and the heavier still fell faster than the lighter. Newtonian physics answers with Aritotle that on Democritus' supposition all the atoms should have " infinite " velocity.

Furthermore, if we *suspend* the gravitation or other extrinsic force, leaving the body with only the momentum with which it entered the vacuum, then that momentum, having no resistance on which to expend itself, must insure the uniform motion of the body through the vacuum. To *start* the motion a force must operate, to *retard* or to *stop* it a resisting force must operate; but in the absence of such resistance no continually operating force, surely, is needed to produce a motion that is already a fact. Aristotle, not Galileo, is the true forerunner of Newton.

Yet even Newton failed to grasp the true nature of motion. Newton said that *all* bodies move. " Newton held to a kinetic atomic theory. This theory conceives of nature as composed of

[1] Translated by Henry Crew and Alfonso De Salvio. Macmillan, N. Y., 1914.

atoms of matter every one of which is moving. . . . On this basis it would be possible to talk about all but the one taken as referent as being in motion, but meaningless to talk about *all* of them as having the property of motion . . . because to take an atom as a frame of reference automatically defines rest and thus renders it impossible to talk about the atom which is taken as referent as moving" (F. S. C. Northrup, in *Philosophy of A. N. Whitehead*, p. 173). Aristotle did not say that *all* bodies move, he said that one body did not move, the Earth was his frame of reference. If his critics had studied him more carefully they would have withheld many of their thoughtless censures.

II

In the whole of philosophical literature no single subject has given rise to more controversies than has the subject of motion. It is not alone that motion is difficult to define. Such intellectual giants as Aristotle and St. Thomas admit as much.[2] There is a psychological fixity, often engendered by the controversy itself, whereby, when a man has publicly defended his theory of motion, he becomes immobile. Newton was aware of this, and that is why he so studiously avoided controversy. It was in this connection that he first employed his famous dictum, "Hypotheses non fingo." But the force of that guiding principle is lost unless we put the emphasis on "fingo."

In popular literature the ultimate degree of scorn is reserved for Aristotle's oft-repeated assertion that "Whatever is moved, is moved by another." But even so simple a thing as ordinary syntax should have made the critics stay their vitriolic pens. The verb *move* is transitive. When it is used in the active voice it requires an object; as the oarsman moves the boat. When it is used in the passive voice it supposes an agent; as the boat is moved by the oarsman. Anything *moved* must be moved by another. It is true that we sometimes employ the verb in an intransitive sense (or middle voice), making it synonymous with "travel." That, too, has its application in the discussion of motion, as we shall see; and Aristotle was fully aware of it. But the misunderstanding on this point has, more than anything else, occasioned the conviction that our modern explanation of motion is in flat contradiction to the ancient.

[2] Cf. St. Thomas, *Phys.*, III, 3; *Metaph.*, XI, 9.

It is a common personal experience of us all that to put a body in motion or to deprive it of motion requires force. Bodies resist being given motion and resist being robbed of it. Also we recognize that there are media which offer resistance. But the resistance of the body itself is a fact only so long as the body is being accelerated; that is, so long as the motion is being speeded up, slowed down, or having its direction changed. The historic question has been: Suppose the body is *not* being accelerated, and there is *no* resistant medium; is a force then required for the body to continue in motion? Although these conditions are, to the best of our knowledge, nowhere realized in the whole universe, so that in fact the answer cannot be given on a basis of observation or experiment, nevertheless philosophers have essayed to give a definitive verdict. It is widely taken for granted today that the moderns contradict the ancients in their answer to this question. The fact is that they do not; the answer given by both is the same: the body will continue indefinitely with the same velocity and direction it had at the start. Let us, tracing the answer back through its history, take four outstanding examples.

Newton: Law I. Every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it.[3]

Descartes: If a portion of matter is at rest, it does not begin to set itself in motion; but once it is in motion, we have no reason to suppose that it will ever be compelled to cease moving, so long as it does not meet with anything that retards or stops its motion. . . . Every moving body has a tendency to continue moving in a straight line.[4]

St. Thomas: If the motion be in a vacuum, one cannot assign any reason why the body in motion should stop anywhere. . . . Therefore [in a vacuum] either every body is at rest and nothing in motion, or if anything be in motion, it must continue in motion forever (in infinitum) so long as it does not meet with a greater body to retard its imparted motion. . . . Hence, since a vacuum offers no resistance, it will continue in motion forever in any direction.[5]

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[3] *Philosophiae Naturalis Principia Mathematica*, "Axioms, or Laws of Motion" (Motte's translation). In the original: Corpus omne perseverare in statu suo quiescendi vel movendi uniformiter in directum, nisi quatenus a viribus impressis cogitur statum suum mutare. To object, as has been done, to the use of "status" to indicate both rest and motion seems little more than to cavil about inaccuracies due to the inadequacy of language.

[4] *Principes*, II, 37, 39.

[5] *Phys.*, IV, Lect. 11 ad fin.

Aristotle: No one could say why [in a vacuum] a thing once set in motion should stop anyhere: for why should it stop *here* rather than *here?* So that thing will either be at rest or must be moved *ad infinitum*, unless something more powerful gets in its way.[6]

The doctrine of all these four is identical, and the very wording is so nearly so, that not only St. Thomas but Descartes and Newton would appear to have copied their statements directly from Aristotle.

The case which they suppose is of course a purely theoretical one, because a perfect vacuum is as unknown in the Newtonian universe as it was in the Aristotelian. For though the medium, or field, through which the planets travel is non-resistant to their motion, still there are gravitational, electric and magnetic forces at play there. Newton himself accepted the "aether." And if Aristotle poked fun at those who postulated a vacuum, Newton was more grim in his condemnation of them. "That one body," he says, "may act upon another at a distance through a vacuum, without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man, who has in philosophical matters a competent faculty of thinking, can ever fall into it."[7] In the Copernican system the force of gravitation is continually accelerating the planets by making them describe orbits instead of following the tangent, and the planets repay the compliment by proportionally moving the sun itself. In this sense each is being moved, and being moved by another. The astronomers of Aristotle's day supplied him, it is true, with a somewhat different version of gravitation. For them, as also in the Copernican system, gravitation was exerted radially with respect to the central body, the Earth, but there was gravitation upward as well as downward. Each of the four elements gravitated toward its own sphere according to its property of relative lightness or heaviness. Today we accept the fact that lighter bodies ascend only because they are forced upward by the heavier bodies taking the positions nearer the center. As Roger Cotes says in his Preface to the Second Edition of Newton's *Principia:*

[6] *Phys.*, IV, 8, 215[a], 19. Oxford translation. It should be noted that as "stop" is understood in the intransitive sense, so too is "move."

[7] *Letter to Bentley*, Jan. 17, 1692-(3?). Cf. *Works of Richard Bentley*, Vol. 3, p. 210.

" That which is relative levity is not true levity, but apparent only, and arises from the preponderating gravity of contiguous bodies." For all that, gravitation is still as much a mystery to us as it was to the ancients.

But if acceleration and the overcoming of resistance are the only changes which, as all are agreed, require the concurrent operation of an active cause or force, why did the ancients demand the activity of an " intelligence " to account for the rotation of the outer sphere of the heavens? The answer is easy. According to the accepted astronomy, especially of Eudoxus and Calippus, the heavens were overcoming resistance, they were " doing work." Expounding Aristotle, St. Thomas says of the diurnal rotation of the heavens, that " Should this motion cease, all others would cease." Not alone the radiation of the heavens but their motion as well was required for all expenditure of energy in the sublunary world; the immediate agents of natural processes possess only such power as " terrestrial bodies have from the efficacy of the heavens, which . . . give the power of motion to other bodies." [8] In present-day astronomy the uniform progressive motion of the astronomical bodies is conditioned on their not doing, by their motion, any " work." On that condition Aristotle, too, would agree, as we have seen, that they need not be " pushed."

For the ancients and the moderns there is unanimity of agreement on the principle that a continuously and concurrently operating cause is required only while acceleration is being effected or resistance being overcome. While a change is being produced, there must be some agent producing it. But the principle does not mean (aside from the conservative power of God) that the agent must continue acting *after* the change has been effected, continue producing after the production has ceased. This is clearly seen by considering the opposite operation. When a body is in motion, a force is needed to bring that body to rest, to " accelerate " it to a stop; but the force does not continue to act, so as to *keep* the body in the condition of rest. Hence when a force has generated motion, it may cease acting and is not needed to keep the body at the velocity it then has. If, after the withdrawal of the force, the body begins to suffer a diminution

[8] *Phys.*, III, 1; IV, 8 ad fin. Cf. *New Scholasticism*, XVI, 3, "Aristotle on Motion."

of velocity, such diminution is being effected by a counter force, as gravitation or the resistance of the medium. It is only in the ideal case of uniform rectilinear motion in an absolute vacuum that there is no need of a continually acting force, or "mover."

The Bond Between the Physics and Metaphysics [9]

One is likely to think that while the *Metaphysics* is about *being*, the *Physics* is about a long outmoded *physical science.* That the science is far from being completely outmoded I have tried to show in the preceding pages, but here I should like to concentrate on a theme which runs through both the *Commentaries.* The great subject in the *Physics* is, of course, motion, and the treatise culminates in a discussion of the Prime Mover. But does this make it very different from the *Metaphysics?* Let us take a few examples:

> If the Prime Mover is eternal and not moved, it cannot be an *ens in potentia,* because such an *ens* is capable of being moved. Instead, it must be a substance existing of itself, and its substance must be act. . . .
>
> It is evident that the reason he [Aristotle] here gives for the sempiternity of time is not valid. For if we suppose time to have begun we need only suppose that prior to that there was only imaginary time; just as we say that beyond the heavens there is no body except an imaginary one. . . .
>
> It is to be remarked that after the first translatory motion [that of the "first heavens"] Aristotle mentions only the motion of the planets, because the motion of the fixed stars had not been discovered. Hence he thought that the eighth sphere, in which the fixed stars are, was the prime mobile. . . .
>
> That there are many motions of the planets is discovered in three ways. There is the motion observed by the common man. There is another motion which is discovered only by instruments and calculations. This requires more or less time. There is a third motion which requires a theoretical explanation. . . .
>
> As to how many planetary motions there are, let us now give what the mathematicians tell us. . . . What they do not tell us we ought to investigate for ourselves or be guided by those who do investigate, should anything later come to light through competent investigation. And since a man should not be led by his liking or aversion for the author of an opinion, but rather by the evidence of the truth,

[9] The remainder of this Chapter is taken from *Modern Schoolman,* XXII, 1 (Nov. 1944), 16-23.

> therefore he says we should be friendly to both parties, those whose opinion we follow and those whose opinion we reject. Both have striven for the truth, and in that way have helped us.[10]

These passages, and there are more of the same kind, are in the genuine tenor of the final Book of the *Physics*, but they are taken from the final Book of the *Metaphysics*. So, if *finis coronat opus*, the *Metaphysics* should not be compared to the *Physics* as "Hyperion to a satyr."

Yet in both *Commentaries* St. Thomas distinctly transcends Aristotle. He does so not only by his greater clarity, consistency, and the deduction of conclusions which Aristotle failed to see, but by being throughout more of an existential philosopher than the Stagirite was. The latter did make *existing* reality his forte, but he did not completely extricate himself from the fascination of Plato's separated essences or "forms." Aquinas makes the break complete. He intends that everything he asserts shall be based on actual existing reality; every true predicate is in the last resort existential; every time we can be said to *know*, we somehow know an existent.

This principle that actual existence is a necessary content of all knowledge is constantly repeated by St. Thomas. "Each thing is knowable to the extent to which it is an actual existent (*ens actu*); hence things which have a deficient and imperfect existence, as matter, motion, and time, can of themselves give us but little knowledge."[11] If "knowledge" were to exceed what the thing *is*, it would be falsity and not knowledge. The knowledge of anything must be confined to what the thing is, "measured" by it. When we have learned all that motion or matter is, in itself, and nothing more, our knowledge, despite the difficulty in acquiring it, is very poor in content, because there is so little existential content in the object of our knowledge. What

[10] *In XII Meta.*, lect. 6, n. 2518; lect. 5, n. 2498; lect. 9, nn. 2558, 2565, 2566. (Numbers of sections are from the Marietti edition of the commentary on the *Metaphysica*, the Leonine edition of the commentary on the *Physica*.)

[11] *In II Meta.*, lect. 1, n. 280; cf. *In I Physic.*, lect. 7, n. 3. The author of *De Natura Generis*, whether St. Thomas or not, is explicit in the same vein. "We shall first take up that with which all knowledge must begin and end. I mean existing reality. Existing reality is the prime object of the intellect. The degree to which anything exists is the only degree to which it can be known."—c. 1. Cf. *In IX Meta.*

motion *implies* is very rich in content, but what motion is, is so poor as almost to escape the grasp of knowledge.

WHAT "POSSIBLE" MEANS

But if knowledge is of existent reality, is there no knowledge of the possibles? And does not St. Thomas discuss the possibles in the Metaphysics? In approaching these questions we must remember that all knowledge is derived from experience, and there is no experience except of actually existing things. In this way knowledge of the non-existent is anchored to existence, nor can it so transcend experience as completely to part company with it. A potentiality, even an objective potentiality or a pure possible, is known only through some existing reality. But, although St. Thomas discusses, and concedes our knowledge of, "possibles," it would be a mistake to identify them with what is meant by the term in most manuals of Ontology; and a much greater mistake to identify them with the Platonic "Ideas." What he means by a "possible" is an already *existing* thing with a passive potency for change. Thus in the *Physics* he speaks of the mobile, the very body which is undergoing change, as "possible." It is synonymous with the movable. "Motion is the actuation of the possible, precisely as possible" (*In III Physic.*, lect. 2, n. 8).

So insistent is he on defining "possible" with reference to the actual that he seems to give almost a Cartesian definition: "Possible things, deriving their name from 'potency,' all have reference to one first potency which is the prime active potency, the source namely of change in another precisely as other. For a thing is said to be 'possible' from the fact that there is something else which has active power over it" (*In V Meta.*, lect. 14, n. 975). But it is clear that St. Thomas is not speaking of the "pure" or objective possible, as Descartes was; he is speaking of the already existing mobile, being reduced to further actuation. That actuation is *motus*, and *motus* is the actuation of the mobile (*In III Physic.*, lect. 4, n. 1). Enforcing the same theme he continues:

> Among other acts the most known and evident to us is motion, which is sensibly perceived by us. To it therefore was first given the name "act," and from motion the name was extended to the others.

> For that reason, "being moved" is not said of non-existing things, though some other predicates are affirmed of the non-existent. Thus we say that the non-existent are conceivable or imaginable or even desirable, but we do not say they are being moved. Because, since "being moved" implies an actual existent, it would follow that the non-existent existed (*In IX Meta.*, lect. 3, nn. 1805-6).

Here we may be given pause by the statement that "some predicates are affirmed of the non-existent." But these predicates express "privation and negation," and as such they imply an existing something just as truly, though not so evidently, as motion does, because "privations and negations are said to 'exist' in that they remove something" from an existent—which existent, we are reminded, is ultimately substance. For "to this [to substance], as to the first and fundamental, all the others are referred." That is only another way of saying that if anything exists, substance must exist. Substance (of some kind) is a necessary existent. Hence any predicate totally dissociated from existent substance would be vacuous. All predicates with any meaning must directly or indirectly assert existing substance.

EXISTENT REALITY DETERMINES TRUTH

In all this, the point which St. Thomas is making is that existence is the determinant of truth, and that truth is not the determinant of existence. With Plato it would seem to be the other way round. He seemed to argue: the "ideas" are necessarily true, therefore they must somehow exist. The positions of the two men are diametrically opposed. Yet one may, with the proper explanations and without deserting St. Thomas' stand, speak of the "necessary and eternal *possibles*." Such possibles do not actually exist, and whatever status one accords them they must not be understood as anything prime and underived; in their very concept they presuppose an existent something. St. Thomas however does not use the word in that sense. In the fifth book of *Metaphysics*, for instance, the term "possible" constantly recurs, but whenever he uses it, not as an adjective but as a noun, he means an existing being with a potency for change. Thus only the patient is called a possible. (If the agent be referred to as *possibilis*, that is by way of extrinsic denomination with reference to the passive potency of the patient which the agent actuates.) In the ninth book he returns to the same theme, de-

claring that it is by reason of its passive potency that a "possible" may be substantially or accidentally changed. "It follows that none of the bodies substantially incorruptible is an *ens in potentia* if we take 'incorruptible' and 'ens in potentia' in reference to substantial change" (*In IX Meta.*, lect. 9, n. 1871). These "incorruptibles" are not in potency even to motion itself, for they already have that, but only to "ubi."

> Whatever is being moved by a sempiternal motion is not in potency to the motion itself; but the motion of the heavens is sempiternal according to what is taught in the Eighth Book of the *Physics*. It follows that the sun and the stars and the whole heavens are always acting because they are always in motion, and by their motion they act. . . . This is said in conformity with the nature of the heavenly bodies as we learn that nature from observation — but not to the prejudice of the divine will, on which their motion and their existence depend (*In IX Meta.*, lect. 9, nn. 1876, 1879).

This passage not only shows how the accepted astronomical theories of the *Physics* are employed as exemplifications of basic metaphysical doctrines, but the closing remark makes us wonder whether St. Thomas was not tempted to add: Prior to their existence the heavens were pure possibles. If he was tempted, he did not yield. As always, he seems to be afraid that such possibles might be mistaken for Plato's "separated forms." In fact he closes the chapter with an attack on them.

> Plato postulated separated forms which he claimed most truly existed. It is as if I were to postulate a separated knowledge, which he called "knowledge by itself." Such knowledge he said was the foremost in the order of things knowable. The same for 'motion by itself' in the order of things movable. But, by the arguments just given, something must first exist prior to any "knowledge by itself." For it was shown that the actual is by its perfection prior to potency. And knowledge is itself a kind of potency (*In IX Meta.*, lect. 9, n. 1882),

St. Thomas is always primarily seeking the cause which actuates, and since only the existential can actuate, the goal of knowledge for him is the existent. Only subsequently is he interested in what is actuated, the potential, "the possible." In Plato's system the world of ideas was the primary; in St. Thomas', more so even than in Aristotle's, the world of ideas is a derivative. Nowhere can we free ourselves from the existent

as the object of knowledge, not even when we deny existence. It is true that "Negations of the things [accidents, generation, etc.] related to substance, or even of the substance itself, are said 'to exist.' Thus we say, 'The non-existent *is* non-existent.' But that could not be said unless existence somehow pertains to its negation" (*In IV Meta.*, lect. 1, n. 539).

The *Metaphysics*, then, is not a treatise on things remote from and foreign to the actual world. It is an exposition of *existing* reality; and by the same token our mastery of it must stem from and be rooted in actual experience. When we say that the subject of Metaphysics is "being," we mean existing being and whatever is implicit in such being. At the top of the list stands substance. "For 'being,' simply, means that which has existence in itself, namely substance. Other things are called 'beings' because they belong to this being" (*In VII Meta.*, lect. 13, n. 1; *In XI*, lect. 3, n. 2197; *In XII*, lect. 1, n. 2419; *In V Physic.*, lect. 2). Substance is being par excellence, and it may be material or immaterial. Next highest on the list is active potency. Active potency is an *actus*, it signifies existence — not the absence thereof, as passive potency does—and it is the counterpart of the "possible" (*In V Meta.*, lect. 14, n. 975).

ACT AND POTENCY

The subject-matter of the *Metaphysics* falls neatly into act and potency. But when we turn to the material world we are met by the disturbing fact of *motion*. Motion seems to be neither act nor potency, or else both.

> It is to be noted that one thing may be in act only, a second in potency only, and a third midway between potency and act. Now what is in potency only is not yet being moved; what is already in completed act has already *been* moved; therefore that thing is *being* moved which is midway between pure potency and act, partly in potency and partly in act (*In III Physic.*, lect. 2, n. 3).

Motion is neither simply act nor simply potency. It is incomplete act, it is an actuation in process of further actuation. "Though such an act is difficult to comprehend, because of the mixture of act and potency, yet that there be such an act is not impossible; it is a fact" (*In III Physic.*, lect. 3, n. 6). Here is the province of the *Physics* — motion and its implications. Al-

though the implications ramify far and wide, their center is always *ens mobile.*

Plato could find an " idea " for whatever was simply act. He could find none for the mixture of act and potency which is motion. Here is where St. Thomas best shows how he bases his knowledge on the existential world. Explain it as you will, motion is a fact. "Among other acts the most known and evident to us is motion, which is sensibly perceived by us " (*In IX Meta.*, lect. 3, n. 1805). Let metaphysics consider things which are act only or potency only, the material world forces us to consider that which is both potency and act. Motion, with all it involves, demands a special treatise, and whether that treatise should come before the *Metaphysics* or after it, the *Physics* treats a special case of reality.

Since motion is such an elusive thing, one might be tempted to relegate it to the realm of the imaginary and unreal. That is practically what is done by many modern philosophers who represent motion as " atomic "; they atomize it into a succession of static states or " stills." St. Thomas does not refuse to face the facts. He could indeed have dodged the issue by translating Aristotle's definition by " actus entis," and so have left the existential nature of motion in doubt. Instead, to preclude any misunderstanding, he employs a term he does not often use, " existent ": " Motus est actus *existentis* in potentia, secundum quod huiusmodi" (*In III Physic.*, lect. 2, n. 3). With both "actus" and " existentis " in the definition he leaves no doubt about his putting motion in the existential order. Moreover he faces the fact that although the categories are a complete classification of existing things, motion is not one of them. It has to be " reduced " to the categories. And, unlike prime matter which is reduced to the single category substance, motion is reduced to four; directly to quantity, quality, and place, indirectly to relation. After his masterly discussion of the categories, or *predicamenta*, and motion's place in them (*In III Physic.*, lect. 5, n. 15) you feel that he has successfully weathered the supreme test of the existential philosopher.

IMPORTANCE OF THE PHYSICS

It is not to be thought of course that motion is the only subject-matter of the *Physics*, nor the only difficult one. Material things

are so fraught with imperfections and indefinites (" infinities ") that, though their existence is obvious, they are lowest in the scale of existence and are barely over the border-line. Metaphysics can serenely treat substance as such without *ex professo* descending into the maelstrom of the material world. Many a man shrinks from that adventure, because, as St. Thomas says in the opening Lectio of the *Physics*, material things, though the objects of our immediate experience, require the greatest amount of observation and inductive study before they can be organized into a " science." Yet that work must be done, and constantly revised, lest metaphysics itself become dissociated both from experience and from the actual world. That such has been the fate of many a spurious metaphysic is too well known to need comment, and it has brought upon even genuine metaphysics a most unmerited contempt.

It must not be forgotten that material things, though the least of beings, clamor the loudest for an explanation. Witness St. Thomas assigning fewer tasks to mathematics and metaphysics than those that are the lot of the philosophy of nature (*In I Physic.*, lect 1). Not only the elements and integral constituents of bodies but their material, formal, final, and efficient causes must be investigated. There are, besides, such concomitants as time and space and the infinite divisibility of the continuum. In a word, the extreme of passive potentiality is found in material things; they are, more than anything else, the " corruptibles," the " possibles," and they challenge the philosopher to discover the corresponding actualities. Perhaps the angels do not need metaphysics, or not our kind of metaphysics, but for us humans immersed in this material world through which alone we can contact all reality, metaphysics must grow out of that world.

WHAT SCIENCE NEEDS

Perhaps the greatest mission of our metaphysics today is to justify itself in the eyes of the scientists and to show them that it is what they need in order to rationalize their various scientific disciplines. Science has come to mean for many a mere statement of the succession of antecedent and consequent phenomena, without any connection other than the succession. There is no statement, rather there is a denial, of anything being *produced* by its antecedents. That is a denial of efficient causality. And

though a recognizable uniformity of structures and activities is accepted, yet with the rejection of final causality, and, as a consequence, formal causality, no *reason* can be given for that uniformity, which is of the very essence of scientific knowledge.

But, granted true continuous change, there is nowhere else so insistent a need for a continuously operating efficient cause. So long as things continue in the condition in which they are, whether that be motion or rest, the evidence of such cause is remote. But when things are in the process of change, the evidence is immediate and as prolonged as the process. Inquiry is the watchword of science, but science has repudiated the inquiry into causes. To lull ourselves into a sense of reasonableness in this repudiation we have employed such soporific phrases as " changing things," as though change were the inherent nature of things and a rational ultimate. The *Physics* of St. Thomas should convince any one that if by " changing thing " you mean that a thing may change itself, your statement is irrational, for nothing can have such a nature. The subject of change is never *changing*, it is *being* changed. The thing which is undergoing change is a *patient*, a " possible," and it needs an agent distinct from itself to effect the change.

So completely have we lost sight of the fact that change is *pati*, that there is in modern languages no real synonym for the Latin " patitur " or " passio." The truth is that when change is predicated of what we call " changing things " it cannot be correctly expressed by either an active or an intransitive verb, but only by a passive. These things are not changing, they are being changed. And if you say to a modern savant that the uniformity of structure and activity of material things is due to formal and, ultimately, to final causes, he will think that you are bringing in what he calls " religion " instead of science or philosophy. Yet this same man appeals to the same existential visible world which St. Thomas used as the starting point of his entire philosophy. Not only does St. Thomas start with it, he never loses sight of it. Though he scales the heights of metaphysics he never forgets that his ladder rests on the solid earth. But today the battle is not primarily on the heights of metaphysics, it is in *Physics*, as Aristotle and more especially St. Thomas, understood the term.

IV

WHAT MOTION IS *

Lectio 1. Motion and its Implications

1-2. Nature is the source of motion and mutation, as is clear from the definition given in the Second Book. (The difference between motion and mutation will be explained in Book Five.) And since motion enters the definition of nature, then not to know motion is not to know nature. So, our purpose being to expound the science of nature, we must explain motion.

3. Aristotle first takes up certain concomitants of motion; because, first of all, when one discusses any subject he must discuss the questions it gives rise to. The subject and its concomitants form one science.

Intrinsic to motion is the 'infinite.' That is because motion involves the study of continuities (Cf. Book VI). And the 'infinite' enters the definition of the continuum. The additive infinite of number derives from the infinite division of the continuum. Thus, authors defining the continuum say, for example, that it is divisible *in infinitum.* There is also another definition given in the *Predicamenta:* a continuum is that whose parts are inclosed within a single common boundary. Since a continuum is a total, it can be defined by its parts. But the parts are regarded in two ways with respect to the total: as the continuum is composed of these parts; or is resolved into these parts. The definition here is by way of resolution; in the *Predicamenta* by way of composition. It follows that the 'infinite' is intrinsic to motion.

Others things are extrinsically consequent on motion; these are its extrinsic measures, as place, vacuum and time. Time is the measure of motion itself. Of the mobile *body* the measure really

* A translation of the first five *Lectiones,* Book Three, of St. Thomas's *Physics.*

The only omissions are the analytic references to Aristotle's text, which usually occur at the beginning of paragraphs; otherwise, they are indicated by dots. Marginal numbers are those of the Leonine Edition.

is place; though in the opinion of some vacuum is the measure. That is why he says there cannot be motion without place, vacuum and time. The fact that not every motion is local is no obstacle, because only what exists in a place is subject to motion. Every sensible body is in a place, and only of such can there be motion. Besides, the first motion [that of the outer sphere] is local motion; if it be stopped, all others will stop. (Cf. Book VIII.) Hence, for the reason given, these four concomitants of motion are subjects for the philosopher of nature.

4-5. Another reason he gives is that these four are common to all things physical. Since therefore the *Physics* is about all of corporeal nature these subjects must be taken up first; because, as was said at the beginning, the study of the general attributes precedes that of the specific. And among the general, motion must be treated first, because the others are consequent on it.

6. He sets down three headings. The first is that 'being' is divided into potency and act. This is not a division into categories, because potency and act are found in every category. Secondly, 'being' is divided into the ten categories. Of these the first is *hoc aliquid*, that is a substance; another is 'how much' or 'what kind' or some of the other predicamenta. The third heading is about a single category, relation; because motion in some way belongs to this category, in that the mover is related to the mobile.

About this last it is to be remarked that, since relation has a most tenuous existence, consisting as it does only in a reference to something else, it has to be founded on some other accident. The more perfect accidents are nearer to the substance, and it is through their mediation that the other accidents inhere in the substance. Now relation is especially founded on the two that have respect to something else, namely quantity and action. For quantity can be the measure of something *external* to it; and an agent activates something *else*. Some relations therefore are founded on quantity; and in particular on number, which is basic to measuring, as is clear from 'twice,' 'half,' 'the square' and other powers, and the like. So also 'same,' 'like,' 'equal' are founded on 'unity,' which is the elemental constituent of number. Other relations are founded on 'actio' and 'passio,' either by past act, as father is related to son, or by the power to

act, as master to a slave over whom he has control. This heading the Philosopher explains fully in the Fifth Book of the *Metaphysics*. In the present passage he touches on it briefly, saying that one kind of relation is by way of excess and defect, and this is founded on quantity, as 'twice' and 'half'; another relation is that of agent and patient, mover and moved, which clearly have relation to one another.

7. Then he shows how motion is reduced to these headings. There are two steps. He first shows that there is not any motion outside the categories of those things *in* which motion may occur. Secondly, motion is divided as the categories are divided. About the first, it is to be noted that, since motion, as will appear later, is an imperfect actuation, and since the imperfect comes under the same category as the perfect, not indeed as a species of it, but by reduction (as prime matter is in the category 'substance'), it follows that motion is not outside the categories of the things in which motion can occur. . . . And this is clear from the fact that everything which is being moved is being moved either with respect to substance, or quantity, or quality, or place, as will be shown in the Fifth Book. But we are not to understand that to these categories there is something univocally common, as their genus, something not restricted to a single category, but the genus of them all. 'Being' of course is *analogously* common to them, as will be shown in the Fourth Book of *Metaphysics*. It is plain then that neither motion nor mutation is outside the said categories; because nothing is outside them, seeing that they are a complete division of being. How motion is connected with the category of action or passion, will be shown later.

8. He then shows that motion is divided as the categories are divided. A thing may belong to any of the categories in one of two ways, either as perfect or as imperfect. The reason for this is that privation and possession is the prime contrariety, and is found in all contraries (Cf. *Metaph.* X). Hence, since all the categories are open to contraries, there must be in all the categories the perfect and the imperfect. Thus in 'substance' one thing is like form, another like privation; in 'quality' one is like white, which is perfect, the other like black, which is as it were imperfect; in 'quantity' the one is the perfect size, the other imperfect; in 'place' one is high, which is like the perfect,

one low as imperfect; or the light and heavy which are put under 'place' because of their tendency. Hence there are as many classes of motion as there are classes of being. For the species of motion vary according to the different categories of beings; thus augmentation, a motion in 'quantity,' is different from generation, which is motion in 'substance.' The species of motion also differ as perfect and imperfect in the same category; for generation is a motion in 'substance' toward form, corruption toward privation; and in 'quantity' growth is toward the perfect size, diminution toward the imperfect size. Why two species are not indicated in 'quality' and 'place' will be explained in Book Five.

Lectio 2. The Definition of Motion

1. The Philosopher has discussed the necessary preliminaries to the definition of motion. Here he defines motion. First in general, then in particular.

2. About motion in general, it is to be noted that some authors define motion as any transit that is not sudden, from potency to act. Their mistake is to insert in the definition of motion things that are posterior to motion. For transit is a species of motion. Also the 'sudden' in their definition brings in time; because that is sudden which happens in an indivisible instant of time. But time is defined by means of motion.

3. Hence it is altogether impossible to define motion by the prior and the better known, in any way except as Aristotle here defines it. As was said, each category is divided into potency and act. Now, since potency and act are prime divisions of being, they naturally are prior to motion; and that is why Aristotle uses them to define motion.

It is to be noted, then, that one thing may be in act only, a second in potency only, and a third midway between potency and act. Now what is in potency only is not yet being moved; what is already in completed act has already *been* moved; therefore that thing is *being* moved which is midway between pure potency and act, partly in potency and partly in act. This is clear in the case of alteration. For when water is only in potency hot, it is not yet being heated; but when it is already boiling, the process of heating is terminated. On the other hand, when it is

acquiring something of heat, though imperfectly, then it is being moved toward heat; for what is being heated acquires gradually more and more heat. This imperfect actuation of heat existing in the heatable subject is motion; not indeed by reason of what it already actually is, but because, already existing in act, it is still tending toward further actuation. This is so because, if the tending to further actuation were stopped, its very actuation, however imperfect, would be, not motion, but the terminus of motion. This is the case when something is halfway heated. On the other hand the tending toward further actuation belongs to an 'existent in potency to such actuation.' Likewise if the imperfect act be considered *only* as potency to additional actuation, it has not the nature of motion, but is the starting-point of motion. As the process of boiling can begin from the freezing-point, so too can it begin from the lukewarm. Therefore the imperfect actuation has the nature of motion, at once as a potency with respect to further actuation, and as an act with respect to the less perfect. Consequently motion is neither the potency of the existent in potency, nor the act of the existent in act; instead, it is the actuation of the existent in potency. It is called 'act' in reference to a preceding potency; whereas it is said to be 'of a thing in potency' in reference to further actuation. Therefore, most properly does the Philosopher define motion as the 'entelechy,' i. e., '*the actuation, of an existent in potency, precisely as being actuated.*'

4. He then exemplifies the definition in all the species of motion. Thus alteration is the actuation of the alterable as being altered. But motion in 'quantity' and 'substance' have not a single name, as motion in quality is called alteration; so he gives two names for motion in quantity. He says that the actuation of the augmentable and its opposite, the diminishable, is augmentation and diminution. That of the generable and corruptible is generation and corruption. That of the locally mutable is local motion. He here takes motion broadly for mutation, not strictly, as contrasted with strict generation and corruption, as will be explained in the Fifth Book.

5. He next explains the different parts of the definition. First with regard to motion as 'act,' then 'or the existent in potency,' and thirdly 'as being actuated.'

About the first he makes two observations. An act is that by which a subject previously in potency to something, actually becomes that something. But a subject previously in potency is actually *becoming* while it is being moved. He says it is clear, then, that motion is just that, namely an actuation. For instance, 'buildable' implies a potency to something. But when in keeping with that implied potency, the buildable is being reduced to act, we then say that it is being built. The fashioning it is receiving is its actuation. The same holds for all other motions, as teaching, healing, tumbling, dancing, adolescence (growth) and aging (diminution). It is to be noticed that *before* anything is moved it is in potency to *two* actuations; namely to the perfect actuation, which is the terminus of the motion; and to the imperfect actuation, which is the motion. Thus water before it begins to be heated is in potency both to being heated, and to boiling. But while it is being heated it is being reduced to imperfect actuation, namely motion; but not yet to the perfect actuation which is the terminus of the motion; with respect to that it continues in potency.

6. Secondly, he explains how motion is 'the actuation of an existent in potency.' Here is his reasoning. Every actuation is properly the actuation of that in which it is always found. Daylight is always found in the atmosphere, and for that reason it is the actuation of the atmosphere. But motion is always found in some 'existent in potency.' Therefore motion is the actuation of an existent in potency. To explain the minor premise, he says that in some cases the identical thing is both in potency and in act, though not simultaneously nor in the same respect. Thus a thing is hot in potency and cold in act. So, too, many things act and are acted upon by one another, in the sense that each in its own way is in potency and in act with respect to the other. And since all the sublunary natural bodies have the same sort of matter, therefore in each there is potency to that which is actual in another. Thus in all such there is something which acts and is acted upon, moves and is moved. For that reason it has seemed to some that absolutely every mover is also being moved. More will be said about that later on. As will be shown in the Eighth Book of this work and in the Twelfth of the *Metaphysics,* there is a mover which is immobile, because it is not in potency but in act only. When, however, any actual

existent, possessed of a potency, is moving either itself or something else, in whatever way it is 'mobile' (that is, capable of being reduced to the act of motion) ; then, whether it be moved by itself or by another, its motion is its actuation. Whence it is that things in potency, whether they are acting or being acted upon, are being moved; because in acting they are subject to reaction, in moving they are being moved. Thus fire when it acts on kindling is reacted upon to the degree of the smokiness of the flame.

7. Lastly he explains that clause in the definition of motion which reads 'as being actuated.' First by an example. He says it was necessary to add 'as being actuated,' because the thing which is in potency is also something in act. And although the existent in potency and in act is the same subject, it is not the same with respect to its being in potency and its being in act. Thus the brass is actually brass and in potency to being a statue, but the reason why it is brass as such is not the same as its potency for the statue. Now the motion (molding) is not the actuation of the brass as brass, but its actuation as in potency to the statue; otherwise as long as it remained brass is would have to continue being molded, which is clearly false. So it was correct to add 'as being actuated.'

8. He then gives an argument from the 'contraries.' It is evident that the same given subject is in potency to contrary things. Thus lymph or blood is a single subject in potency to health or disease. But being in potency to health is one thing, being in potency to disease is another. (I mean of course with respect to the different objectives.) Otherwise, if '*can* be sick' and '*can* be well' were the same, it would follow that to *be* sick and to *be* well were the same. It is evident then that the reason why the subject is a certain kind of being is not identical with its potency to something else. Otherwise, the potency to one thing would essentially be the same as the potency to its opposite. So also color does not mean the same as being seen. Hence it was necessary to say that motion is the actuation of an actuable subject ('possibilis') precisely as being actuated ('possibile'); lest it be thought that motion is the act of the thing itself which is in potency, considered as that precise kind of subject.

Lectio 3. Defense of the Definition

1. After giving the definition of motion and explaining its several phrases, he here turns to defending the correctness of the definition; first directly, then indirectly.

2. His direct defense is the following. A thing in potency is one that *can* be in act. Now, a buildable is in potency. Therefore there can be some actuation of the buildable precisely as being built. This is either the house or the building process. But the house is not the actuation of the buildable as being built, because the 'being built' as such is being reduced to act while the building process is going on. But when it is already a house, it is no longer being built. We are left with the conclusion that the building process is the actuation of the 'being built' as such. But the building process is a motion. Therefore motion is the actuation of an existent in potency precisely as being actualized. The same holds for all motions. It is evident then that motion is the kind of actuation it was declared to be. Only while anything is being moved, it is in such actuation; neither before nor after that. Before that, when it is in potency only, the motion has not begun. After that, when it has altogether ceased to be in potency, there is no motion because it is in completed actuation.

3. His indirect defense of his definition is that motion is not correctly defined any other way. There are three steps to his argument. He first states his own position; secondly he sets down and refutes the definitions given by other authors; thirdly he gives the reason why they have so defined motion. Under the first heading he declares that it is clear that motion is correctly defined, from two considerations: from the fact that the definitions which others have given are inapplicable; and from the fact that motion cannot be defined any other way. The reason is, because motion cannot be put in any other classification than that of the actuation of an existent in potency.

4. Under the second heading he rejects other definitions of motion. Others have defined motion in three ways.[12] They have said that motion is *otherness,* because that which is being moved is always other and other. Likewise they have said that motion

[12] Cf. Plato, *Soph.*, 256^{d-e}; *Tim.*, 57^{e}, 58^{c}

is *inequality,* because what is being moved is always nearer and nearer to its term. They also said that motion is that which *is not,* or *non-being,* because that which is being moved, while it is being moved, does not yet have that to which it is being moved. Thus what is being moved toward whiteness is not yet white

These definitions the philosopher disposes of by three considerations. First, with regard to the subject of motion. For if motion were otherness or inequality or non-being, then whatever subject these inhere in, must necessarily be being moved; because whatever is the subject of motion is being moved. But things which are other need not, simply because they are other, be in motion; neither must the unequal, nor the non-being. It follows that otherness, inequality, non-being are not motion. Secondly, with regard to the terminus ad quem, motion and mutation are no more toward otherness than toward likeness, no more inequality than equality, no more toward non-being than toward being. Generation is a mutation toward being, corruption toward non-being. Hence motion is not otherness rather than likeness, or inequality rather than equality, or non-being rather than being. Thirdly, with regard to the terminus a quo, just as there is a motion away from otherness, and from inequality, and from non-being, so there is also a motion away from their opposites. Therefore motion should not be put in these classes any more than in their opposites.

5. Lastly he gives the reason why his predecessors have so defined motion; first the immediate reason, then the underlying cause. First, then, the reason why the Ancients put motion in the said classifications (namely otherness, inequality and non-being) is that motion seems to be an indeterminate thing, that is, incomplete and imperfect, as though it had no determinate nature. And because it is indeterminate, it ought, so it seems, to be put in the class of privations. For Pythagoras set down two orders of things, and in each of these he set down ten principles. The principles in the second order were called by him 'indeterminates,' because they are privatives. They are not determined by a form in the category of substance, nor by a form of quality, nor by any special form existent in one of these, nor by the form of any of the other categories. In the one order the Pythagoreans were wont to put these ten: finite, odd, one, right, masculine, rest, straight, light, good, equilateral triangle. In the other:

infinite, even, plurality, left, feminine, motion, curved, darkness, evil, not equilateral.

6. He then gives the reason why motion is put among the indeterminates. It is because motion can neither be put under potency nor under act. It if be put under potency, then anything in potency, say, to a certain size, would be changing in size. If it be included under act, then anything that had actually attained its size, would still be changing in size. Now it is indeed true that motion is an act, but it is an imperfect act, intermediate between potency and act. That it is imperfect act is clear from the fact that the thing whose act it is, is an existent in potency, as was said above. And that is why it is difficult to grasp what motion is. At first thought it seems that it is either simply act, or simply potency, or is contained under privation, just as the Ancients said it was contained under non-being and inequality. But none of these is possible, as has been shown. There is left, then, only the aforesaid way of defining motion: that it be such an act as we have declared; an act, namely of an existent in potency. Though such an act is difficult to comprehend, because of the mixture of act and potency; nevertheless it is not impossible that such an act occur, for it does occur.

Lectio 4. *Subject and Cause of Motion*

1. Having defined motion, the Philosopher here determines whose act the motion is, whether it is the mobile's or the mover's. It can be said that he now gives another definition of motion which to the previous definition is as the material to the formal, and as conclusion to the premise. Here is the definition: motion is the actuation of the mobile in as much as it is being moved.[13]

[13] The phrase, "in quantum est mobile," might have been omitted, and the definition made to read: "Motion is the actuation of the thing being moved." But St. Thomas was unable to express it that way in Latin, because that language has no present participle passive, such as the English "being moved." To overcome this difficulty he resorts either to the present indicative, "quod movetur," or to the verbal noun, "mobile." Both signify that the body is *now* being moved. Aristotle had a similar difficulty. There is indeed a present participle passive in Greek, but it is indistinguishable from the middle voice. The reader could not tell whether it meant "moving itself" or "being moved" by another. Such ambiguity would have been fatal to Aristotle's doctrine on motion.

This definition follows from the previous one. For, motion is the actuation of an existent in potency, precisely as being actuated; but such existent is the mobile, and not the mover; because the mover as such is an existent in act; therefore motion is an actuation of the mobile, precisely as being actuated.

2. About this he makes three observations: that motion is the mobile's actuation; how it is related to the mover; and how a certain difficulty is answered. . . . To begin with, he grants that it does happen that a mover is also moved.

3. That a mover may also be moved he shows in two ways. First because anything which is now in potency and afterwards in act, is in some manner moved. But the mover is seen to be first a mover in potency, then a mover in act. Such a mover is therefore being moved. That is why he says that every mover, since it is in some sense a mobile in potency to motion, is moved. This is clear from what has been said, namely, motion is the actuation of an existent in potency. That is the case with every physical mover: every physical mover is also being acted upon.

4. The same is clear from another consideration. If a thing's being deprived of motion is its coming to rest, then that thing has motion. And since losing motion and being put in motion are opposites, their production concerns the same subject. But the mover's privation of motion, its cessation from motion, is called coming to rest. Things are said to be coming to rest when they are ceasing to act. Every such mover, therefore, namely one whose privation of motion is its coming to rest, is itself undergoing change.

5. He then shows how it happens that the mover is moved. That happens not by the fact that it is doing the moving, but from the fact that it moves by *contact*. To move is so to act as to move something. That which is thus affected by the mover, is the thing being moved. But the acting is by contact, since bodies act by touching. It follows that the agent is simultaneously a patient, because by touching the other, it itself suffers a change. This is so when there is mutual contact, when what touches is also touched. That is the case with things which share the same matter; each of them is affected by the other when they touch one another. However, the celestial bodies, because they do not share the same matter with the inferior bodies, so act

upon them as not to be affected by them, they 'touch but are not touched,' as is said in the First Book *De Generatione*.

6. Returning to his definition, he concludes from what has been said, that although the mover be moved, nevertheless motion is not the actuation of the mover, but of the mobile as such. To be moved is merely incidental to the mover, and does not belong to it essentially. Hence, if anything is being moved, in the sense that the motion is its own actuation, the motion is not the actuation of a mover but of a mobile. That motion is merely incidental to the mover is clear from what was said above; namely, the motion, which is the actuation of the mover's potency for change, comes to the mover from its contact. Hence while it is acting it is also being acted upon; so its being moved is incidental to the mover. That it does not belong to the mover essentially he makes clear from the fact that the mover is always some *form:* in substantial transmutation the mover is some substantial form; in alteration, it is some qualitative form; in augmentation and diminution, some form in the genus of quality is the mover. These forms are the causes and originators of the motion, because every agent acts by its form. That is because every agent acts to the degree in which it is actual. Thus actual man, from what is potentially man, produces actual man. But, since everything is actual by its form, it follows that the form is the moving principle. Consequently, to produce motion is due to the thing's having a form, by reason of which it is in act. But motion is the actuation of a subject still in potency; hence motion is not the property of anything as mover, but as the thing 'being moved.' That is why in the definition of motion it is said that motion is the actuation of a movable in the process of being moved.

7. He now raises a difficulty based on the foregoing. It is an old debate in certain circles whether the motion is in the mover or in the thing being moved. But that problem is solved by what has already been said. For it is evident that the actuation of anything is in the thing of which it is the actuation. But the actuation 'motion' is in the mobile, because it is the mobile's actuation, though produced in it by the mover.

8. He goes on to explain how the motion is related to the mover. First he states the proposition: that the act of the moving agent is no other than the actuation of the thing being moved.

So, although the motion is the actuation of the thing being moved, it is also in a way the act of the moving agent.

9. There are three points in his clarification of the proposition. First he shows that the mover has an act as well as the thing being moved. For anything of which act and potency are predicated has some act suitable to it. Now, just as the thing-being-moved is so called because of its potency to be moved further, and is said to have been moved because of its acomplished act in having progressed thus far; so, too, a mover is a potential mover because of its power to produce motion, and an actual mover in the very acting whereby it is producing the motion. To each, therefore, to the mover and the thing being moved, there must belong some act.

10. Secondly, he shows that the act of the mover and of the being-moved is the same act; for it is predicated of the mover inasmuch as it is doing something, and of the thing-being-moved inasmuch as it is receiving something; but that which the mover by its action causes, is the same thing as that which the being-moved by its passion receives. This is what he means by saying that the mover is the activator of the mobile; that is, it effects the actuation of the mobile. Wherefore the one act must be the act of both the mover and the being-moved. The product of the mover as the causal agent is precisely what is in the being-moved as the patient and recipient.

11. Lastly he confirms the proposition by examples. For instance, the transit is the same in fact from one to two, as from two to one; but they differ in relation. Two, as the starting point, is twice its term one; one, as the starting point, is half its term two. Similarly, the space involved in ascent and descent is the same, but they are called 'up' or 'down' because of the difference of starting point and terminus. The same is true of mover and being-moved. For motion, as proceeding *from* the mover to the thing being moved, is the act of the mover, as it is in the thing being moved, it is the act of that thing.

Lectio 5. Is Motion in the Mover or the Moved?

1 After the Philosopher has shown that motion is an act of the mover and of the moved he takes up a difficulty concerning that proposition. . . .

2. He begins by conceding that the question is debatable, there being likely arguments on both sides. He then makes the preliminary observation that there is an act of the agent and an act of the patient, just as it was said that there is an act of the mover and of the moved. The act of the agent is called 'action'; that of the patient is called 'passion.'[14] His proof for this is that whatever is the function and purpose of anything, that is its act and its perfection. But since the function and purpose of the agent is action, and of the patient, passion (as is self-evident), it follows that action is the act of the agent, and passion is the act of the patient.

3. He then takes up the difficulty itself. It is clear that both the action and the passion are motion, because each is identical with motion. Hence, (I) either the action and the passion are the same motion, or (II) they are different motions. If they are two different motions, each of them must be in some subject. Are both, then, in the patient, the moved? Or is one of them, the action, in the agent; and the other, the passion, in the patient? If one should say, conversely, that what is in the agent is the passion, and what is in the patient is the action, he would be speaking equivocally, calling the passion action, and the reverse. However, Aristotle seems to omit a fourth case, namely that both are in the agent. But he skips that because it was proved that there *is* motion in the mobile; and that is why this case, of neither being in the patient but both in the agent, is omitted.

4. II. *If there are two Motions:* (1) *Is one in the Agent?*

Of the two cases he touches upon, he begins with the second. If you say that action is in the agent and the passion in the patient, yet action is a motion, it follows that there is motion in the mover. The same reason must hold for the mover as for the

[14] The Latin "actio" is properly translated by the English "action." But there is no English equivalent for "passio." *Passio* indicates the condition of "being affected, being modified, having something done to it" by another. The English word "passion" usually implies violent reaction; "passive," on the contrary, means *not* affected. "Passivity," being an abstract term, only makes matters worse. One could perhaps for "actio" say "the doing," and for "passio" say "the done to," or "the undergoing"; but these expressions are awkward. So it was thought best to employ "passion" simply as a technical term with the above defined meaning.

moved, namely that in whichever one of them there is motion, that one is being moved. In other words, as with the mover and moved, so with the patient and agent: in whichever one there is motion, that one is being moved. Consequently, either every mover is being moved, or else something has motion and yet is not moved. Neither alternative is acceptable.

5. (2) *Are there two Motions in the patient?*

He then takes up the other case, declaring that if any one says that both the action and the passion, being two motions, are in the patient, the moved; and that the instruction proceeding from the instructor, as well as the learning, which is on the part of the learner, are both in the learner, then two inacceptable consequences follow. First, we have maintained that the action is the act of the agent. If, then, the action is not in the agent but in the patient, we will have to concede that the proper act of a given thing is not *in* the thing of which it is the act. The second is that the same one thing is moved with two motions. For the action and the passion are here supposed to be separate motions. But in whatever thing there is a motion, that thing is moved with that motion. So, if both the action and the passion are in the mobile, then the mobile is moved with a double motion. This would be the same as if there were two alternations of the same subject which terminate in the same species; a single subject, for instance, would be becoming white with two whitenesses. That is impossible; though of course the same subject may be simultaneously undergoing two alterations that terminate in different species. That is quite possible. But it is clear that action and passion terminate in the same species; because what the agent is doing, is identical with what the patient is having done to it.

6. I. *If the Motion is one Act, then there are Four Difficulties.*

'Is there then but one act?' He considers this possibility. You can say that the action and the passion are not two motions, but one. This however leads to four difficulties. (a) First, that the one act is the act of things of different species. For it has been said that the action is the act of the agent, the passion the act of the patient ; yet the agent and patient differ in species. If, then, the action and the passion are the same motion, the consequence is that the one act is the act of things of different

species. (b) The second difficulty is that, if the action and the passion are the same motion, then the action is identical with the passion; and instruction, proceeding from the instructor, is identical with learning on the part of the pupil. (c) The third is that to act is the same as to be acted upon, to teach is the same as to be taught. (d) The fourth, consequent on this, is that every teacher is being taught, every agent has the role of a patient.

7. He now solves this problem. From what has been said, it is clear that the action and the passion are not two motions; they are one and the same motion. As deriving *from* the agent it is called action, as being *in* the patient it is called passion.

8. So there is no need to answer the difficulty which supposed that the action and passion are two motions.

An additional Difficulty.

But there is still another difficulty, even supposing that the action and passion are one motion. Namely, granted that the action is the act of the agent, (e) then if action and passion are one motion, it follows that the act of the agent is somehow in the patient; so that the act of the one is in the other. But under the second heading four difficulties emerged. So now there are five to be solved.

Answer to (*a*) : '*the act proper to one is in the other.*'

9. First, then, there is no inconsistency in the act of one thing being in another. Instruction indeed is the act of the instructor, but, so long as it continues without interruption, it is being imparted by him *to* another person. Hence the act is his, the agent's, as the one *from* whom, and yet it is *in* the patient, as received *in* him. It would of course be repugnant if the act of the one, in the same *way* in which it is his act, were in the other.

Answer to (*b*): '*Instruction is the same as learning.*'

10. Next, can the same act be an act of the two? He answers that there is nothing against that, so long as the act, though one in itself, is not one and the same in its relation. Thus, as was said, the passage from two to one, and from one to two is the same; so also, from the potential to the active, and conversely. Likewise, an act, the same in itself, is the property of the two

by a different relation; it is the agent's as being from him, and the patient's as being in him.

11. To the other difficulties, which hang together, he replies in reverse order.

Answer to (*e*): '*The Agent's act is in the Patient.*'

He turns at once to the final one as the most thorny. To this, the fifth, he replies that it is not necessary for the instructor to be learning, the agent to be acted upon, despite the fact that what the one is doing and the other having done to it, are the same. We do not mean, however, that they are the same in the sense that two things with a common nature, as tunic and garment, are the same. We mean that they are identical in subject, yet different in relation; like the journey from Thebes to Athens and from Athens to Thebes, as was said above. Things which are the 'same' need not be identical in every way; they can be the same merely in what they are; or in what they are, plus a relation. Therefore, even granted that to act and to be acted upon are the same, still, not being identical in relation, it does not follow that everything which acts is also acted upon.

Answer to (*d*): '*every agent is a patient.*'

12. As regards the fourth difficulty, even if instruction is identical with the pupil's learning, it does not follow that to instruct and to learn are identical. Instruction and learning are spoken of in the abstract; to teach and to learn are said in the concrete. These latter refer to the ends or terms, in keeping with the different relationship of action and passion. Thus, although there is the same space between distant objects, speaking in the abstract; nevertheless, if we refer to the termini of the space, as when we speak of the distance from here to there and from there to here, it is not one and the same.

Answer to (*c*): '*action and passion are identical.*'

13. He answers the third difficulty by rejecting the inference that if the action and passion are one motion, then action and passion are identical. He says that in the final analysis it does not follow that action and passion are identical, or that instruction and learning are the same; yet the motion in which each of these inheres is the same. This motion indeed by one relation

is action, and by another relation is passion. It is one thing to be, by relation, an act 'of this as *in* this'; it is another thing to be an act 'of this as *from that.*' But motion is called action inasmuch as it is an act 'of the agent wherefrom'; it is called passion in that it is an act 'of the patient *wherein.*' Thus it is clear that though the *motion* of the mover and of the thing-being-moved is the same because it abstracts from both relations, still the *action* and the *passion* differ, because they include these different relations in their very meaning.—From this it is clear that since motion abstracts from the relation of action and passion, it is not, as some have asserted, contained in the category of action, nor in the category of passion.

14. But on this point there still remains a double difficulty. In the first place, if action and passion are the same motion, and do not differ except by relation, as has been said, it seems that action and passion ought not to be two categories, since the categories are classes of concrete things. Secondly, if motion is either in action or passion, no motion will be found in the categories substance, quality, quantity and place, contrary to what was said above; but motion will be contained only in action and passion.

15. To clear up this point, we must remember that 'being' is sorted out into the different categories, not univocally, as genus is divided into several species, but according to the different ways of existing. Now the different ways of existing correspond to the different ways of predicating. For in predicating something of something else, we say 'this is that.' That is why the ten classifications of being are called the ten predicamenta.

All prediction is done in three ways. (I) One way is had when there is predicated about a subject that which belongs to its essence; as when I say 'Socrates is a man,' or 'man is an animal.' This gives us the category of substance. (II) Another way is had when there is predicated of something that which is not a constituent of its essence, yet is proper to it. This either expresses the matter of the subject spoken of, and so is the category quantity (because quantity proper is consequent on matter; thus even Plato spoke of 'the large' as pertinent to matter) ; or else it expresses a form, and so it is the category of quality (even when the qualities are founded on a quantity, as

color in a surface or shape in lines and planes). (III) Or again the subject itself is characterized by a reference to something other than the subject, and thus it is the category of relation (for when I say 'the man is a father,' nothing absolute is predicated about the man but, instead, there is predicated a reference which is in him toward something outside him). The third manner of predicating is had when the predicate expresses something *extraneous* to the subject, by way of characterizing the subject. Even accidents, though contingent, are thus predicated of substances. We say, for instance, not 'the man is whiteness,' but 'the man is white.' To be characterized by something extraneous is in a way common to everything, but there is a special case in which it is peculiar to men alone.

In the manner common to all, a thing is characterized by something extrinsic either on the score of cause or on the score of measure. For a thing 'caused' or 'measured' is thus denominated by something extraneous to its essence. True, of the four causes, two are parts of the essence, namely the matter and the form. Hence a predication expressing either of these pertains to the category of substance; as when we say 'man is rational' or 'man is corporeal.' The final cause, on the other hand, does not cause anything separately from the efficient; for the end has the rôle of cause only in so far as it moves the agent. So, as to causes, there is left only the efficient cause, whereby a thing can be characterized by something extraneous. Consequently, anything characterized by its efficient cause is the category of 'passion'; because to be a patient is nothing else than to be made by the agent to undergo something. Conversely, anything which, from its effect, is denominated the efficient cause, is the category of 'action'; because action is what is done by the agent to another, as was explained above. As for measure, one kind is external, another kind internal. Internal measure is the height, width and thickness proper to a given thing; it is by these that a thing is characterized by an intrinsic property. External measures are 'the time' and 'the place' Accordingly as a thing is characterized by the time, we have the category 'when'; by the place, it is the category of 'where' and of 'posture.' This last adds to 'place' the arrangement of the parts in that place. It was not necessary to make a like addition to 'the time,' because

the temporal order of parts is given in the very nature of time; that is because time accompanies motion with respect to earlier and later. So a thing said to be ' when ' or ' where,' receives its denomination from ' time ' and ' place.'

But there is a thing peculiar to man. For nature herself endows other animals with whatever is sufficient for the preservation of their life, as horns for defense, a thick and hairy hide for covering, hoofs and such like for walking without injury. So when these animals are said to be ' armed ' or ' clothed ' or ' shod,' they are not so characterized by something extrinsic to them, but by certain parts of their very selves. Hence, for them, the predicate falls within the category of substance; just as, for example, a man is said to be ' handed ' or ' footed.' But such equipment as was mentioned above could not be given by nature to man, both because of the subtlety of his makeup, and because of the multiplicity of activities which are proper to man as a rational being. For all of these a set of special implements could not be constructed by nature. In place of such, man has reason. By means of his reason he provides himself with *exterior* equipment to take the place of those things which in other animals are inherent. Consequently, when a man is said to be armed, or clothed, or shod, he is so denominated by something extrinsic to himself. And that extrinsic thing has not the nature of a cause nor of a measure. So there is a special category, and it is called ' habit.' However, it must be remarked that this predicate is also attributed to other animals; not indeed as considered in their own nature, but because of the way they are employed by man. In this sense we denominate a horse as ' harnessed ' or ' saddled ' or ' caparisoned.'

16. It is now clear that, although motion is a single thing, nevertheless the categories which concern motion are two; that is, there are two when the predicamental denominations are formed from things *extraneous* to the motion. For the agent is one thing, from which as from something extraneous, is derived, by way of denomination, the category ' passion.' The patient is another thing, and from it the agent is denominated. And here is the solution of the first of our difficulties [Cf. n. 14: that there ought not be two such categories].

17. The second difficulty [*ibid.*: that there then would be no motion in substance, quantity, quality and place] is easily solved. For the nature of motion is fulfilled not alone by what is true of motion in the external world, but by what the mind also apprehends. Motion in the external world is nothing but an imperfect actuation, which is the formative phase of a perfect act in the thing being moved. Thus what is becoming white is already beginning to be something in the order of whiteness. But that this imperfect thing have the nature of motion, it is further required that we understand it as intermediate between two stages. The preceding stage is related to the motion as potency is related to act; wherefore the motion is called 'act.' The subsequent stage is related to the preceding motion as the perfecting to the imperfect, or as act to potency. For that reason, as has been declared, the motion is called the actuation of the existent in the potential stage. Therefore, however incomplete a thing may be, if it is not progressing toward completion, it is denominated the terminus of motion, and not motion; for by motion a thing *continues* to be moved. An instance of this is had when a thing is beginning to become white, and the alteration is suddenly interrupted. So far therefore as concerns motion in the external world, a motion is reduced to that category which serves as a terminus for that motion. [Namely, substance, quantity, quality, place.] As was said above, the imperfect is reduced to the category of its perfect state. But as to what the mind knows concerning motion, namely that it is an intermediate between two termini, this involves the relation of cause and effect, For a thing is not brought from potency to act except by an acting cause. In *this* way motion belongs to the category of action and passion; because, as was said, these two categories are got from the relation of efficient cause and effect.[15]

18. Lastly, Aristotle defines particular motions. In fact, by declaring what motion is in general he has already said what it is in a particular case, because from the general definition of motion it is clear how a particular species should be defined. For, if motion is the actuation of a mobile while being moved, it

[15] The Categories are also treated by St. Thomas in *Metaphysics*, V, Lect. 9.

follows that alteration is the actuation of an alterable while it is being altered, and so of the others.—And because the question was raised whether motion is the act of the activating agent as the ' from which,' or whether it is the actuation of the subject as the ' in which,' therefore for the removal of any lingering obscurity, let us say still more explicitly that the motion is the act of the power of the active cause, and it is the actuation of the passive subject. Then shall we be able in a particular case to say that the building of a house is the act of the builder, and it is the actuation of the house in the process of construction. And the like can be said about healing and other processes.

PART TWO

CONTENT OF THE PHYSICS

V

ST. THOMAS'S COMMENTARY ON THE PHYSICS OF ARISTOTLE

PRÉCIS

Book One—PRINCIPLES

1. *Subject-Matter*

Physics is the study of material substances. Not, indeed, in all their aspects, but as subjects of continuous processes, or *motus*. Now, every organized study starts with certain "principles" determined by the subject-matter under investigation. For Physics, the principles are: (a) the constituent *elements* of which bodies are composed; and (b) the *causes* involved in continuous processes. A cause is that which is necessary for the production of a thing. Physics has to do with all the causes: the extrinsic (efficient and final); the intrinsic (material and formal). In this, Physics differs from Metaphysics, which, since it studies substance as such, leaves to Physics the study of what is peculiar to material substances. Material things, though the objects of our immediate experience, require the greatest amount of observation and inductive study, before they can be organized into a "science."

2. *Meaning of "Nature"*

"Nature" is a principle of activity or change, actual or possible. Thus the material world, where change is most obvious, is called "Nature." An the study thereof is called "Natural Science" (or the philosophy of Nature).

3. *Monism*

The entire material world, because of its contrary qualities, its discrete quantities, its divisibility, and because it is composed of substances and accidents, cannot be simply one individual

substance, as Parmenides, Melissus and others contended. It cannot be one in reality nor one in a perfectly univocal concept.

4. *Extreme Pluralism*

On the other hand, the fact that we can formulate many predicates about the same subject does not mean that the subject is many existential individuals. An existing thing can be one subject with many qualities. Especially, it may be actually one and potentially many.

5. *Is the World Infinite?*

If the world were not produced, only then would it necessarily be infinite. Nor does such infinitude have any relation to the infinite *extent* of the world, which Parmenides and Melissus illogically deduced from it as a consequence. However, even granted a world infinite in extent, there could, contrary to their contention, be movement in such a world; because the *parts* could move about. As for the world's *duration,* it is to be noted that there are time processes and timeless facts. Motion is a time process, substantial change as such is not. And from the last named it is evident that there are many species of things in the world, which therefore cannot be one infinite individual.

6. *Parmenides' Views*

Parmenides did not make any distinction between substance and accident, nor between the potential and the actual. And even granted that what "truly *is*" (quod vere est) is substance, *ens;* still there is another sense in which "ens" includes accident. Again, on his supposition that there is no such thing as potency, to say that "ens est unum" is to exclude extended being; because extended being is in a sense many, since it is divisible. Lastly, of accidents, some (the contigent) are separable from their subject, others (the proper) are inseparable, as the fact that man is a biped. With Parmenides, all would have to be inseparable.

7. *Accident as "Non-ens"*

The Platonists made the continuum consist of indivisible ultimates, and also took ens as a genus, whereas it is substance that is the genus. On that basis, accident is in a sense non-ens. Now,

accident is not "ens simpliciter," but that does not mean it is "absolute non ens."

8. *The "Physicists"*

Now come the Natural Philosophers or "Physici," those who admit motion. Yet, even these want to derive everything from a single principle, namely from one of the elements. They all neglected earth, as too gross. They took one of the other three, or something midway between a pair of them, as something denser than fire and more subtle than air. Generation was just by rarefaction and condensation, as air by condensation became water, and by rarefaction became fire. The rarer had less of matter, and so were more excellent. Empedocles finally won the day with his four elements.

9. *Elements neither one nor Infinite*

All the Physicists took it as true that nothing comes from nothing, so they explained becoming by rarefaction and condensation or by separation and conjunction. That was because they did not advert to potency and act. "Entity in potency is as it were intermediate between pure non-entity and actual entity. Natural products are therefore not produced from mere non-entity, but from entity in potency, not from entity in act." So it is not necessary that when water becomes air, there be pre-existing actual particles of air in the water, which are liberated.

There cannot be an actually infinite number of parts in an animal or plant; nor can the parts be indeterminate in size. Whatever may be said of the mathematical continuum, "in a natural body there is found a natural form, which requires a determinate size, just as it requires other accidents." Hence there must be a limit to the size of the particles that make up any natural body. This does not impugn the mathematical continuum, because there the parts can be progressively smaller without limit.

Some totals are compounded and resolved into parts of the same kind (and these are the elements), as a house is compounded of bricks and resolved into the same; but not so with other things, as houses are not made of other houses. In compounds, as also in transmutation of elements, the product is different from what it is generated from and from what it is resolved into. Thus

there is no need of either only one principle or of an infinite number of principles.

10. *Aristotle's own Doctrine*: (*a*) *Everything from Contrary*

Having done with unacceptable explanations, Aristotle now turns to the quest of the true position to take. But he first sets the problem of Democritus. " The full and the void, he said, were the principles of nature; the full he ascribes to being, the void to non-being. Also, though the indivisible bodies were all of one nature (unius naturae), yet diverse things were composed out of them by reason of their diversity of shape, position and arrangement."

All the Physicists admit some sort of contraries, and everything that is produced is produced from something not identical with the product. Anything that is produced or destroyed did not exist before it was produced, nor exists after it is destroyed. Hence that which becomes something else and that into which the something else is resolved, must not include the actuality (esse) of the thing that became or was corrupted. That things thus come from and are resolved into their contraries is clear enough in the case of transmutation of elements, but not so clear in the formation of compounds, since these latter are mediate between the elements; yet it is true of the compounds, too, because they are derived from the elements, and these are contraries to one another. Aristotle credits his adversaries with following reason, even though their *reasons* were not clear to them. " For the true is the good of the intellect, toward which it is naturally directed. . . . So man's intellect sometimes tends by natural inclination to the truth, even though he does not see the reason for the truth." (Aristotle then shows the different ways his predecessors regarded the contraries.)

11 (b) *Three Principles suffice*

How many principles must we accept? Not one only, because change involves contraries. Not an infinite number because: (a) we could never know nature if we had to learn an infinite number of its principles; (b) the first principle must be substance, and that is one only genus; but a genus has a *first* pair of contraries, so not an infinite number; (c) if a finite number is sufficient, then an infinite number is to be rejected (Empedo-

cles, with his four elements is to be preferred to Anaxagoras, with his infinite number) ; (d) the principles are contraries, but if (with Empedocles) we deny the transmutation of elements, we must make *all* the principles *prime* principles and contraries; yet it is evident that some contraries are *posterior* to others, and some contraries do come mutually from one another, as sweet and bitter. Here Aristotle argues from given doctrines of his adversaries; also when contraries come one from the other, there is a subject common to both. Not otherwise; white itself does not become black. But since there must be a subject, the principles are at least three.

Discussing the question in the context in which his predecessors left it, Aristotle says that none of the elements can be that third principle, because complete substance is a genus that has no contrary. [That is because it is the first genus; only subaltern genera, because they are also species, have contraries.] "The entire generation of things can be accomplished by positing one material principle and two formal principles; because for receptivity one material principle suffices." And since there are but two contraries (contraries being the two extremes), three principles (subject and two contraries) are sufficient.

12. *A Subject is Required*

Nature means the power of activity, change, becoming. And the principles of change are three: the two termini and the subject. The terminus a quo may be simply negative, as non-musical, or it may be privative, as unmusical. In every change that which is not opposed to either term remains; but since the terms come and go, neither *they* remain, nor does the *compound* remain which each of them forms with the subject.

"Becoming *simply* is only the becoming of *substances,* but other things are said to become in a *limited* sense (secundum quid). That is because becoming means the beginning of existence (essendi). For a thing to become simply, it is required that the thing previously simply *was* not. This happens in substantial change. That which becomes a man, not only previously was not a man, but it is true to say that he simply was not at all. But when a man becomes white, it is not true to say that he previously was not, but that he previously was not thus (talis)." The reason is that accidents (quantity, quality and others) re-

quire a subject, substance does not. Yet even substances are produced *out of* a subject.

Kinds of change: alteration of shape (statue from brass) ; addition (river from rivulets) ; cutting away, " abstractione " (statue by sculpture) ; composition, putting together (house) ; change of nature, accidental and substantial. But all these require a subject.

13. *Privation Implied*

" The principles and causes of natural things are the constituents of which they consist and are made, not the concomitants." These constituents are subject and form. Privation is a concomitant of the subject, and it remains even when the subject has a form, that is, there still remains the privation of *other* forms. In generation the opposites are privation and form; in corruption, form and privation; in motion the opposites are both positive (Cf. Book V) , i.e. motion in opposite directions.

Prime matter is not known in itself but through a form. "Thus when we see that what is air, becomes at times water, we must say that something existing under the form of air is at times under the form of water; and . . . this we call prime matter. This therefore is one principle of nature, which is not *a* one, like ' this something,' that is, not like a denominated individual, as though it had form and oneness in reality (actu) ; but it is called ' being ' and ' one ' in that it is in potency to form. Another principle is nature (ratio) or form. The third principle is privation, which is the contrary of form."

14. *Predecessors Overlooked Potency*

The neglect of these principles of change was what led the Ancients to deny change, and multiplicity. They said, being cannot come from non-being. Aristotle answered: " From a being in potency something becomes per se. . . . Matter enters the substance of the thing made."

15. *Matter under Privation is Appetite*

Just as the errant philosophers overlooked matter, so they overlooked privation. "Act and potency divide any category of being (Cf. *Metaph.* IX; *Phys.* III). Hence, just as a potency to a quality is not a thing outside the genus of quality, so the potency to a substantial existent is not a thing outside the genus

of substance." Privation is per se non-entity, matter is non-entity secundum accidens, i.e. by privation. Privation does not seek anything, but the matter under privation does. This appetite does not imply a form, but only a potency. And since matter is the prime subject, it is not generated or corrupted.

Book Two—CAUSES

1. *Causes studied in Physics*

Having declared what are the principles of natural *things*, we now consider the principles of natural *science;* first its material object, then its formal object.

Things are: by nature; by art; by accident (casu). By nature: animals; plants; elements. Natural things have within themselves a principle of motion and rest (status) : with respect to place; to increment; to alteration. This principle is either active or passive (not " incohatio formae "); thus the celestial bodies have a natural motion, even though they be moved by a separate mover. " In the heavy and light bodies however there is a formal principle of their motion; but this formal principle cannot be called an active potency, to which that motion belongs, but is included under passive potency," as an accidental form (heaviness) which follows upon the substantial form—to *be* moved. Not that the motor is the form, for the motor is the generator (generating the element outside its proper sphere). "Nature then is nothing else than the principle of motion and rest—of itself and not contingently." Nature means " nata," inborn. " Nature *is* the subject, in that it is called matter; and it is *in* the subject, in that it is called form."

2. *Material and Formal Cause*

The older natural philosophers did not recognize prime matter, but only second matter, as, e.g. water ; and so all else were only artifical bodies, and their forms accidental. "Now it is true that (prime) matter is substance and the nature of things natural, because it enters into the constitution of every natural thing. . . . Nature in one way is matter, which is subject to motion ; for motion is one species of change. In another way nature is denominated the form and the species. But form is *more* nature than matter is, because form is more in act. Birth

(nativity) is denominated from its term, which is nature; but the term is the form."

3. *Physics not Mathematics*

Physical science studies natural bodies and their accidents, but these latter include the subject-matter of astronomy; and astronomy is a part of mathematics (geometry). But physics is not a part of mathematics, because the mathematician considers lines, points and surfaces in abstraction from bodies. Mathematics considers quantity apart from motion and "sensible matter," but not from "substance" or "intelligible matter," i.e. imaginary extension. The natural philosopher abstracts from individuals, but not from sensible matter. The application of pure mathematics to music and astronomy does not make these intermediate sciences mathematical, because their term is natural matter. Geometry and arithmetic are the only purely mathematical sciences.—The physicist argues that the Earth must be spherical because of the equality of gravitation. The astronomer argues from the Earth's shadow in a lunar eclipse, and from the fact that the same stars cannot be seen from all parts of the Earth.

4. *Not Metaphysics*

Matter is for the sake of the form, form for the sake of the end. End is not only the ultimate term but must also be good ("optimum"). Therefore natural science is about matter and form, or about forms inasmuch as they are in matter. To consider them in themselves belongs to general metaphysics.

5. *Causes Enumerated*

Having determined the subject-matter of Physics, we now turn to the formal object; and this is a quest for the causes or reasons. Material cause is *in* the product. Exemplar cause determines the species. Species is not the form only but form and (common) matter; it is in this species that the individuals participate. Efficient cause is fourfold: (a) perfecting, finishing, gives the substantial form; (b) preparing, disposing, makes the matter apt for the form; (c) adjuvant cause works not for its own end but for the end of the other; (d) "advising," imparts a form by which the thing acts. This last is exemplified in the generation of elements, which by reason of the imparted form go to their

proper spheres. Lastly there is end as a cause, the " why " of things; and ends are both intermediate and ultimate. Material cause is parts, formal cause is total; e.g., the diapason. For material cause we have the elements; for final cause, a good, real or apparent.

6. *Efficient Cause*

A prior cause is more universal, a posterior cause is more specific (proprior.) Thus the sun is more universal, fire more specific. The more superior in entity, the less contracted the form and the more dominant over matter, which restricts the power of a form. Fire is the prime heater; the heavens, the prime alterer.

Any maker of the statue is its cause per se; Polycletus is its cause per accidens, because he happens to be the maker. And a cause may be in potentia (vel habitu) or in actu. A cause in actu is simultaneous with the production of the effect. So the divine Cause is together with the existent; if that Cause were removed the thing would relapse into nothingness (" As, the Sun removed, the light in the air ceases "). But since an effect is not understood unless its cause is known, we come at last to a first cause.

7. *Chance*

Fortune and chance are true causes or they are not (e.g., meeting a friend by chance down town). Previous philosophers wavered on this question; they even said, as Democritus, that the motion and arangement of the heavens were by chance. But plants and animals, generated from specific cells, are not the product of chance; they are the product of intellect; therefore the heavens also. " To some it seems that fortune is a cause, but hidden from human intelligence, as if it were something divine and above men. They wished all fortunate events to be reduced to some divine ordering cause, as we say everything is ordered by divine providence. Now, although this opinion is rightly rooted, they did not properly use the term ' fortune.' For that divine ordering cannot be called fortune, because to the extent that anything shares in reason or order, it is removed from fortune. Hence fortune is rather said to be an inferior cause which of itself has no fitness for the ' fortunate event '; not a superior cause, if any such there be." Aristotle merely dismisses the question with the comment that fortune is not a cause per se, but per accidens.

8. *Unintended Effects*

Aristotle's division is that fortune operates in a small minority of cases only; the regular occurrences are not fortune. St. Thomas (with Avicenna) objects: "a potency is not a principle of action, only act is that"; and "every agent acts for an end"—even when the act is indeliberate, as stroking one's beard. But as there are causes per accidens (as the fact that the builder is a musician), so there are effects per accidens, as the fact that the building cause a quarrel among the neighbors. Such effects per accidens are fortune; as when a gravedigger finds a treasure; chance is "praeter intentionem." The causes per accidens are infinitely variable (not so the cause per se). But mere frequency does not make the thing intended; a man walking through mud does not intend to get wet feet, but is happens every time he does so. Intention is in the will, but that presupposes intellect; and the more the intellect foresees the less chance or fortune there is. Chance is unforeseen effect.

9. *Chance-Effect not Uncaused*

Chance is denominated a cause of unforeseen, or at least unintended, effects, not as though these things had *no* cause, but because they are connected with the per se effect. Thus a man gets a haircut, for appearance's sake, and it by chance relieves a headache. Good fortune and misfortune are usually said of great good or great evil.

10. *Chance or Fortune not Additional Cause*

Chance is broader than fortune (good or bad), because the latter is said only of men, who act freely. Irrational things are not said to have good or bad fortune, though they may cause it in man, as a treasure found, or a stone falling on a man's head. Fortune, then, concerns agents who can intend things; chance concerns things irrational. But since a thing intended is extrinsic to the agent's nature, fortune is from an extrinsic cause; unfree agents act from entirely intrinsic causes, so chance is from intrinsic cause. Yet both intelligence and nature are causes of actions, hence fortune and chance belong to efficient cause. A cause per accidens presupposes a cause per se. But, as there is no cause of mundane things prior to the heavens, the heavens cannot be a cause per accidens, cannot be chance. Chance there-

fore is not an additional cause, over and above those enumerated. Cause answers a *why?* Sometimes the answer is the definition, as a right angle. In unchangeable things formal cause is the all-sufficient answer, but in mobile things we must also seek the material, efficient and final causes.

11. *The Four Causes*

A résumé of the causes treated in Physics: primarily the material and the mover; these result in the form, which is the end sought in generation, and embodies the final cause.

12. *Final Cause Necessary*

Final cause must be considered, because even things without intellect act toward an end, and so must be directed by some intelligence. The Adversaries appeal to the "necessity of matter." They argue thus: "Rain is not for the sake of the crops, it simply results from the necessity of matter. Under the influence of the reflected light of the sun, vapors rise, and when they enter the colder regions above, they descend as rain, either to produce crops or to destroy crops." But we know from the need of rain for growing things, and because it does promote order, that an orderer designed it, whatever mishaps may occur.

13. *Nature Acts for an End*

The constancy of natural events excludes chance; but there is only: either chance or purpose. In natural things, the prior actions are in view of the later; a plant is "born fit" (aptum natum) to build itself, as a house is built by art. Likewise spiders and ants and swallows fashion webs, dens, nests; yet always in the same way; therefore not by their own intelligence but by nature.

14. *Opponents Refuted*

Abnormalities ("nature's sins") only prove the rule. That there is a determinate end is clear from the fact that you reap what you sow. If that were not true there would be no such thing as nature, and nothing unnatural. The fact that natural things do not deliberate is due to their having the *means* determined by nature. If the shipbuilder could impart to the wood his own art, the wood would build the ship, without deliberating.

15. *Necessity*

Absolute necessity if from formal cause; as an animal is corruptible because it is a compound, or a triangle is equal to two right angles. Again there is a necessity of using apt means to an end; thus there is the necessity of using the right sort of matter to attain a given end, as in building a house. But this necessity arises only from the end; the end posited, the necessary matter is posited. But the end is not *such* because the matter is *such;* it is the other way round. In demonstration the definition is the starting-point; in natural (as in artificial) processes, the end, which conforms to the definition (e.g., a house) is also the starting-point; it makes the premises (means) necessary, just as in demonstration the premises make the conclusion necessary. To have a saw you must have iron with teeth. "There is nothing against putting in a definition some reference to matter, not indeed individual matter, but common; and this is necessary in the definition of all natural things. . . . A definition containing the end and form and matter includes the whole process of natural generation."

Book Three—MOTION

1. *Motion a Relation*

After having settled what are the principles of natural things and the principles of the science of them, Aristotle turns to the subject-matter. This, he says, is beings susceptible to motion. First about motion itself. How motion differs from mutation will be explained in the Fifth Book. Since motion is a continuum, and therefore divisible infinitely, the infinite is a concomitant of motion. The extensive continuum, " quantity," in the categories, can be defined as *composed* of parts (because parts added to parts can be fused into one total), but motion must be defined as *resolvable* into parts (because a motion once stopped can never be made continuous with the next motion.) Motion also implies place, vacuum, time—the last being the measure of motion. And "Local motion is the first of motions (motion of the heavens), which ceasing, all others cease." (Cf. Bk. VIII.)

To define motion. Act-and-potency is in each category. Substance, extension (quantity), quality, are not motion. Motion belongs to relation, " ad aliquid." But a relation (accidental, i.e.

predicamental) is founded on some other accident (or accidents). For this, quantity can serve, since it can measure *other* things; also action, because it transfers its action to something else. But since motion is an actus imperfectus, it pertains to the categories by reduction, as, e.g., prime matter to the category 'substance.'

2. *Motion the Actuating of a Potency*

"What is in potency only is not being moved; what is already in perfect act is not being moved, but has already *been* moved." Water at its lowest temperature is in potency only, at the boiling point is in perfect act; in between, it is moving toward its term, toward further act. "If the ordination (ordo) to further act ceases, the very actuation (which it then has), however imperfect, is a terminnus, and not motion; as when anything is halfway heated. But the ordination to further actuation belongs to the existent-in-potency-to that further actuation." But the potency alone is not motion, it is the start of motion; the completed act is the end of motion; motion is therefore act, but imperfect, incomplete. To what precedes, it is act; to what follows, it is potency. "*Motion is the actuation of an existing thing in potency* (to further actuation), *precisely as such.*" This last phrase is added "because what is in potency is also something in act." Shapeless brass is actually brass, but only in potency is it a statue. Nor is it sufficient that the subject be actual, because the same subject can be in potency to opposities, as health and sickness; the subject must be taken as in potency to further actuation.

3. *Motion an unfinished Act*

The actus which is motion is that actus only *while* there is motion. To say that motion is mere " otherness " or " inequality " or " non-ens " is ambiguous, because these can also be said of things that are not motion. Motion is an incomplete, imperfect act. " That such an act is difficult to form a concept of, is due to the mixture of act and potency; yet that there is such act is not impossible, it is a fact."

4. *Motion is in the Body which is being Moved*

Is motion the act of the mover or of the moved? "The mover is found to be first in potency, then in act. . . . This happens in every natural mover. Hence it is that every physical mover

is (also) moved." Rest is the opposite of motion, it is the cessation of motion; but opposites refer to the same subject. Therefore "rest" (quies) is said only of mobile things.

One body moves another by contact, i. e. mutual reaction; each acts and is acted upon. That happens in material things, i. e. patible matter. Celestial bodies can act without being acted upon, their matter is not patible. Yet motion is not the actuation of the mover, *as* mover, but as mobile, movable, with passive (receptive) potency. This passive potency is actuated by the other body reacting on the mover. Motion pertains to the mover per accidens, not per se; because the mover as such (per se) is not in (passive) potency. "Every agent effects motion in accordance with its form . . . form is the moving principle. Hence to be a mover belongs to a thing in as much as it has a form, by which it is in actu (complete)." To *be* moved happens to it in so far as it is not in actu but in (passive) potency. The actus which is motion is in the mobile, though caused by the mover. The active potency (motivum) is in the mover, i. e. it is able to effect motion. And when the mobile has *been* moved its (passive) potency has been actuated, and so it is in actu. "He shows that the act of the mover and the moved is one and the same act. It is of the mover in as much as the mover effects something; it is of the moved in that the moved receives (patitur) something. But what the mover by its action causes is the same as that which the moved as the patient receives." For example, ascent and descent is the same; the direction alone is different; so motion as it proceeds from the mover is the act of the mover, as it is received in the mobile it is the act of the mobile.

5. *Agent and Patient*

Objection: "The actus of the agent (activi) is called 'actio,' the actus of the patient is called 'passio.' . . . And if one say that the action is a motion, it follows that the motion is in the mover." Answer: "It is not repugnant for the act of one thing to be in another, because teaching is the act of the teacher, *from* him however it continually tends and without interruption; hence this same act is his, that is the agent's, as *from* whom; yet it is in the patient, as received *in* him (the learner). It would of course be repugnant if the act of the one were in the other in the same *way* as it is his act."

The motion *from* the agent and *in* the patient is in fact one motion, but is differently related to agent and to patient. This does not mean that action and passion should be one category. The first three categories are absolutes, intrinsic to the subject: substance, certainly, quantity as belonging to the material cause; qualities (properties) as belonging to the formal cause. Final cause has no effect apart from that of the efficient cause. Efficient cause involves a relation; but that does not mean that the cause and the effect must be in the same category [except the general category of relation]. Categories are concrete, not abstract; we say, a man is white, not that he is whiteness; he has a concrete relation to a quality. So, too, we say that a man is armed, or a horse is harnessed; these are relations, and are singled out for special classification because they are not given by nature, but by man. Likewise, " though the motion is one, nevertheless the predicaments which refer to motion are two, since the predicamental denominations arise from different things, external (to the motion: agent and patient) . . . . But that this imperfect thing have the nature of motion, we must further understand it as intermediate between two: (a) what *precedes* is as potency to act, so that the motion is called its act; (b) what *follows* is as the perfecting to the imperfect, or as act to potency. Therefore *motion is the actuation of an existent's potency,* as was said above."

6. *The Infinite*

The Pythagoreans considered every terminus as something finite, but what was inclosed within the terminus was infinite, i.e. divisible anywhere. Those natural philosophers who taught that there was but one principle, namely matter, considered that matter infinite (in extent) ; those who made a plurality of elements the principles, said that the elements were finite in both number and extent. Those who postulated an infinite number of atoms (Democritus and Anaxagoras) postulated " an infinite (extent) through contact."—Now if there is an infinite, it must, they argued, be a principle, because an infinite cannot be something derived. They took terminated to mean actually divided, and thus finite, and derived. The infinite was the unterminated, undivided. They also understood the ingenerable, the incorruptible, to be infinite; and this they called divine, and therefore infinite.

7. *Which Infinite?*

The reasons which have induced men to conclude that there is an infinite are: (a) time, which always was and always will be; (b) the infinite divisibility of extension, for this is the basis of mathematics; (c) perpetual generation and corruption—"that generation will ever totally cease is contrary to the opinion of many"; (d) the seeming necessity that every finite body be enclosed within another, "so that there cannot be an end to bodies"; (e) imagination and intellect do not stop at any magnitude, for "the ancient philosophers considered reality as twin to their thought and sense images . . . and so body must be infinite, just as space is; or even that there must be an infinite number of worlds, as Democritus contended."

"The question is: Is there an infinite, or is there not? . . . It comes to this: What *sort* of thing *is* the infinite? Is it substance or accident?" Now, to begin with, infinite may mean what cannot be "gone through": as a point; or a long journey; or a mathematical line, which cannot be finished either by addition or division. The first (a point) is excluded, because the discussion is about a divisible infinite. The second case is of something divisble, but divisibility is passio or potency, and therefore not an *ultimate* principle (demanded by reason). The third case, mathematical infinitude, is a question outside the scope of the present inquiry, which is whether there is any *body* infinite in extent.

8. *No Actually Infinite Element*

The context in which this problem arises, supposes a body to have boundaries, whether the body be physical or geometrical. Of course, if there is a body infinite in extent, it has no boundaries, except potentially, i. e. boundaries could be carved out. Likewise the multitude of bodies in such a world would not be any definite number; "because (definite) number is a multitude (actually) computed in terms of a unit."

The natural philosophers considered only the four elements (not adverting to the fact that "the heavens are of a nature different from the elements"). But if any of the elements are infinite, all must be: if there is one only, that one is infinite; if several, then all ratio between them would be lost if one were finite, no matter how weak in power the infinite element be. Yet each

element would have to be infinite in all three dimensions and so would leave no room for any other, unless they compenetrated, "which is impossible." But that there is only one element (either one of the four, or one still more fundamental) is contrary to experience.

9. *Universe not Infinite in Extent*

But, elements aside, can any physical ("natural") body be infinite? If the infinite body were made up of parts of the same kind (species), every place would be equally connatural to the parts, and there would be no reason for natural motion and rest. If the body be made up of dissimilar parts, each kind must be finite (as shown above) and so the total is finite. Anaxagoras wanted the infinite to be immobile because it is not supported by anything else; but the Earth is not supported, and yet is not infinite. Besides there is no center to an infinite, and so no bodies could move toward or away from the center. Besides, "the differences of place are six: up, down; front, back; right, left." But these directions cannot be determined in an infinite body. It is impossible therefore that the whole universe be infinite. For no existing body can be of indeterminate position and size.

10. *Infinitesimals*

"From the foregoing it is clear that there is not any body infinite in act." But there must be an infinite in some sense, otherwise there would be an end to the divisibility of the continuum, and an end to number. But as actual division has an actual limit, so actual addition has an actual limit. Some potencies can totally be reduced to act, as bronze to a statue. Other potencies cannot be totally reduced to act. Of these latter, the extensive continuum remains while it is being divided; the successive continuum (motion, time) is not "totum simul." A continuum can be divided endlessly into proportional parts; thus if we do not require that the parts be equal in size, division is the same as addition. For instance, I have a stick twenty feet long. I have two others, each ten feet long. Of the shorter pair I cut one in half, and add that half to the other; then add a quarter, then an eighth, and so on. I can never by that process reach the length of the first stick, twenty feet. Hence there is an addition which cannot reach a definite limit. But I cannot, on the

other hand, assign any definite quantity which cannot be exceeded in smallness by a process of division. Hence, as the potency to division is incapable of being entirely reduced to act, so also is the potency to addition.

11. *The Indeterminate*

"That, outside which there is nothing" is the definition of a total, not of the infinite. For when there is something absent that belongs to it, it is not a total. The unfinished is not a total; the finished is a total, and so is called finished, perfected, perfect. Thus the actual division of the continuum is perfect at whatever point it stops, but it is imperfect in respect to going on to infinity. It is the total that contains, the matter that is contained; thus in this case the infinite does not contain but is contained. An infinite of this kind is "not known," because it has no form, it is indeterminate.

12. *Mathematical Infinitude*

The container is the total, the form, the species; the contained is the parts, the matter, the infinite. "Since therefore in magnitudes we go by division from total toward parts, it is reasonable that no terminus be found there which is not passed by 'infinite' division. But by addition we go from parts toward total, which has the nature of a containing and *terminating* form; hence it is reasonable that there *be* some determinate quantity which infinite addition may not exceed."

"In numbers there is a minimum term which cannot be further divided; the reason is, because every unit, in that it is a unit, is indivisible; just as indivisible man is one man and not many. Every number is resolvable into unity. This is clear from the very notion of number, for number means more than one. And every plurality, more or less exceeding unity, is a determinate species of number. . . . It is clear that division causes multitude. The more a magnitude is divided the greater multitude arises; therefore, upon the endless (infinita) division of magnitude there follows the endless addition of numbers. Consequently, as the infinite division of magnitude is not in act, but in potency, and exceeds every determinate smallness, so the addition of numbers is infinite, not in act, but in potency and exceeds every determinate multitude."

"If it were in the potency of nature that a magnitude increase to infinity, it would follow that . . . every determinate quantity may be exceeded, so that there would be something greater than the heavens. From which it is evident that what some say is false, namely that in prime matter there is potency to (any and) *all* quantity; for there is in prime matter a potency to only a terminated quantity" (terminated by the lowest sphere of the heavens). Besides, division goes in the direction of potency, addition in the direction of act.

By "infinite" a geometer means a line so long that you may take as much as you like; but that does not say that it is infinite. With really existing things it is quite otherwise; they must really be infinite or not.—Matter as informed is not infinite (in potency), for it is "finited" by the form; its unfiniteness is its privation—its capability of having other determinations; and a determinate size is second matter.

13. *No Actually Infinite Quantity*

For generation and corruption to proceed without end it is not necessary to suppose (with Melissus?) that there is an infinite storehouse of material from which supplies for generation may be extracted. We need only recognize that the generation of one thing is the corruption of another, and vice versa. Nor is it true to say that every body must be in contact with another, and so on ad infinitum. "To end" is an absolute; it does not refer to anything beyond. Therefore there can be a finite world not in contact with any other.

To say that there must be something in fact corresponding in size to my every concept and imagination is absurd. Because I can think of or imagine man many times larger or smaller than he is, it does not follow that there must really be all these men of different sizes.

To argue to an infinite in act from the fact of motion and time is to forget that in neither of these is anything in act, except it be the indivisible "now" and the indivisible moving point. The past, or the path, is retained in the mind, but is not the becoming which time and motion are. Hence in material things there is no infinite in act.

Book Four—SPACE AND TIME

Space

1. *Place as Subject and Receptacle*

Now about the things extrinsic to motion. No body undergoes other changes without also undergoing local motion. Just as transmutation led men to the knowledge of a subject that remains, so the change of place—as when water poured out of a vase is replaced by air—led men to consider place as a kind of receptacle distinct from both water and air, and as a terminus of local motion to and from.

Certain places are proper to certain elements, so that place can have a "potency and power" to preserve the elements located there—"not that place has an attractive force, except as the end is said to attract." These localities are not variable, as right and left, etc., but are determined by the motion of the heavens, as mentioned in the previous book. But we must not think that there must exist a receptacle of things, prior to the things themselves.

2. *What Place is Not*

What is place? It cannot be something compenetrating the body, it cannot be identical with the body, it cannot be either an element or a compound, it cannot be a cause. Besides, as Zeno proposes, if it be real, it is also *in* a place, and that in another place, and so on. And does place expand and shrink with the body?

3. *Place neither Form nor Matter*

Common place is that in which many things are contained; proper place is private to one thing; it is the place circumscribed by the boundaries of the thing itself. "But form is the terminus of each thing; for by the (substantial) form the matter of each thing is limited to a given species, and its magnitude limited to a determinate size; for the size of things is a consequence of their forms." But the argument (form terminates; place terminates; therefore place is form) is invalid. Plato wanted place to be space, which was terminated by dimensions, as by form. In the *Timaeus* he says place and matter are the same, not distinguishing between place's reception and matter's

reception. In his lectures he used to say that the receptacle was the great and the small, but he also said that these are matter. But place cannot be form, nor matter, nor habitus, etc., because these cannot exist apart from things, whereas place does, and is immobile.

4. *Derived Meanings of Place*

One thing may be in another: (1) part in total, as finger in hand; (2) total in parts, since it is not outside the parts; (3) species in genus, as man in animal; (4) genus in species, since the genus and the specific difference are in the species as parts in a total; (5) form in matter or subject, as the proper temperature for health, and so any form, substantial or accidental; (6) effect in the power of an agent, as "it is *in* my power to do this"; (7) as in an end—"a man's heart is *in* a certain thing"; (8) something *within* something else, as in a vase. This last is to be in a place. (In the last way a thing may also be said to be in time.) "All the other ways are derived from the last, which is the most proper" way of being *in* another.

To say that a thing is 'in itself" can only mean that it is *not* in another. But can a place be in a place, and so on forever? (Cf. Zeno.) No, not in another as in a place. It may be in another in one of the other seven ways. Nor is place either form or matter, "for form and matter are something of the *placed* (locati), as being its intrinsic parts." Therefore they are not the place.

5. *What Place is*

(a) "The place *contains* that of which it is the place," but not as a form contains; (b) "the place is *equal* to the placed"· (c) "place is not lacking to any placed, yet is separable from the placed"; (d) "in every place there is a difference of up and down." "When a body is out of its proper place it is naturally borne to that place; and when in it, remains there." This holds for the elements, not for the heavenly bodies.

The notion of place arises from the fact of local motion, wherein bodies come and go but the place remains. A thing may move by itself (per se) or with another (per accidens); as a tiller detached from the ship, or moving with the ship. Some things can move only per accidens, as white, knowledge, etc.

"One is said to be inside the heavens as in a place, because he is in the air which is in the heavens. Yet we do not say he is in all the air, primarily and per se; but by reason of the ultimate extremity of the air which contains him, is he said to be in the air; because if the total air were the place of the man, the place and placed would not be equal, which is contrary to the supposition above. But that in which anything is *primarily*, seems to be the extremity of the containing body, and this has the required equality." The container and contained are not continuous, because that would make the contained a part of the same continuum of which the container is also a part. No, the container is contiguous and divided from the contained; and since their extremities are together, they are equal.

6. *The Definition*

Place is not a form, "because form is the terminus of that of which it is the form; while place is not the terminus of that of which it is the place (not the terminus of the contained) but the terminus of the container. Neither is place the dimensions of the (contained) space, dimensions not existing in any body"; because then there would be dimensions within dimensions and overlapping dimensions without end, since the space can be endlessly divided into parts which enclose still other parts.

A boat anchored in a river remains in the same place, though the water flows by; because the successive waters, while around the ship, have the same position (situs) with respect to the poles and the Earth.

Although there is a parallel between matter and place, in that matter remains while forms change, and place remains while bodies change, still the place is not matter; because matter is not separate from that of which it is the matter, while place is separate from the placed. So there is nothing left except that *place is the inner boundary of the containing body*.—Place is immobile, yet "there seems to be no immobile container except space." But Aristotle says that what is immobile is this place with respect to the heavens, whose center and poles are fixed, and whose radius remains the same.

7. *How does the Outermost Sphere "Move"?*

Difficulty: The outermost sphere is not contained in any body, so it is not in a place; hence it cannot be said to move. Alexander answered, it is not necessary for a body to be in a place, since place does not enter the definition of a body. Avicenna: It is motion "in situ." But this will not do, for situs is fixed, like substantial form, which is the terminus of motion. Avempace: Only rectilinear motion, being imperfect, requires a containing body; circular motion need only have a center. The sphere, according to Averroes, is "in loco per accidens," whereas the center is in a place per se. But this is contrary to Aristotle, who says that a thing is in a place per accidens when it is contained within a body which is in contact with the container mentioned as the place, as a man is in the sphere of the moon; and a thing moves per accidens when its immediate surroundings are immobile, as a man on a moving boat. In both cases the thing is *surrounded,* not denominated as itself placed, or as moving. "Therefore I [Thomas] rather favor the opinion of Themistius." It is to be remembered that the notion of place arises from the fact that bodies replace one another in the same place. Hence it is sufficient that one *part* of the sphere replace another. If you object that the sphere has not parts actually, being a continuum, the answer is, first, that parts of a continuum can move about as is seen in parts of water, and, secondly, this is not putting potency before act, because the outermost sphere is moved by the prime mover; and moreover there should be a gradual descent from the immobile mover; and "the variation by parts existing only potentially in place is less than the variation by totals existing in place actually. Thus the first motion, which is circular has less of difformity and more of uniformity, existing nearer to the immobile substances." — The ends of a straight body contain the other parts but are not contained by them. Not so a circular body; each part is contained and contains. The outermost sphere is not (as a total) in a place, except in that per-accidens sense in which the soul is said to be in a place (because it is the principle of movement).

8. *Place is next to the "placed"*

If place be a certain space coextensive with the dimensions of the body, i. e. a "corporeal space between the extremities of the containing body," that space must increase as the contained body increases. Also the place of a point is identical with the point. But if place is the terminus of the container, that terminus itself is not in an (extended) place; so we need not assign real dimensions to unreal space, nor say that a point occupies any space; the point can be "simul cum" the termini of the container.

The placed body is *next* to the container; this accords with the fact that the celestial body has next to it fire as the next noble, and so in descending scale downward. "Thus the affinity of nature, as between the container and contained, is the reason why a body naturally moves to its own place." So, too, water is "simpliciter in potentia" to air, as imperfect to perfect; but air is in potency (by corruptio simpliciter) to water, as perfect to imperfect"; consequently air is next above water. "The Philosopher is here speaking of bodies in respect to substantial forms, which they have from the influence of the heavenly body, which is the first place, and gives the locative power to other bodies."

9. *Disputes about the "Void"*

The early philosophers showed that the air is not a vacuum; for instance, by showing that an inflated bag will support a weight, etc. Democritus thought that if bodies were in contact they would be continuous, and one body; but even in case the whole world is one, there still is a vacuum outside it. These argued against any real vacuum. Others argued that, since bodies cannot compenetrate, vacua are necessary to local motion. Likewise for shrinkage and growth, there must be empty spaces. And they said that a bucket filled with ashes would take as much water as an empty bucket. The Pythagoraeans said that out of the infinite vacuum beyond the world certain small vacua were inhaled into the world to keep things discrete, as they must be, since, for them, things are numbers.

10. *Vacuum Unnecessary*

By vacuum some meant a place without a tangible body, etc., but all postulated a vacuum to give room for local motion. Now, a vacuum is not necessary because "local motion can occur by the fact that bodies encroach upon one another by means of compression (inspissationis)," as is seen to be the case in waves caused by a stone thrown into water. Nor does condensation imply pores, because, as will be seen later (*De Gen. & Cor.*), substantial change (i.e. transmutation) involves augmentation and diminution of the identical continuous matter; so such need not be impossible in the accidental change of local motion.—About the pail of ashes taking as much water as the empty pail, that is due to the condensation of both the water and the ashes.

11. *Natural and Compulsory Motion*

"All the elementary bodies have natural local motions, as the natural motion of fire is upward, and the motion of earth is downward, (others) to the median position. So it is evident that the nature of each body, and not a vacuum, is the cause of its local motion. . . . A natural body moves to its proper place and rests in it naturally, because of the harmony (convenientiam) it has with that place, and because it did not harmonize with the place from which it receded. But a vacuum has no such nature for being in harmony or out of harmony with any natural body. . . . Natural motion is prior to compulsory motion, since compulsory motion is nothing but a deviation from natural motion."

"There is an old dispute about projectiles. The mover and moved must be *together*, as will be shown in the Seventh Book. Yet the object thrown is observed to move even after it is separated from the thrower, as is apparent in a stone thrown and an arrow shot from a bow. Now, supposing there is no vacuum, the dispute can be settled": by (1) communication of the impulse to successive portions of the air; or (2) by a single column of air carrying the projectile along. But there is no push at all if there is a vacuum around the projectile. Besides, in a vacuum, if a body moved at all, by either natural or compulsory motion, it would never change its direction nor come to rest.

12. *Bodies do not de facto Move in a Vacuum*

The speed of a moving body is retarded in proportion to the density of the medium. Every medium, however subtle, has a finite density; a vacuum has zero density. But there is no proportion between any finite quantity and zero. It does not follow from this that the velocity in a vacuum will instantly become infinite. "Because every motion has a determinate velocity in proportion to the power of the mover over the moved, aside from any impediment." There are, in fact, three factors to be considered: (1) the inertia of the body to be moved ("repugnat intentioni motoris") ; (2) a counter force that may be operating, as gravitation; (3) the medium. But Averroes is mistaken in thinking that Aristotle is taking all three into consideration here. He is simply discussing the question of a vacuum, and so is speaking only of the resistance due to a medium, in the case of natural motion, as gravitation. Of course Aristotle does not mean that we may really have corporeal media of any rarity whatever, because the different substantial forms set a limit to the density or rarity of the body.

Another argument against the claim that bodies de facto move in a vacuum is that bodies of different sizes and different shapes (though of the same density) move with different velocities; this is inexplicable except they be moving through a medium, not a vacuum. "It will follow that all will move with the *same* velocity through a vacuum." Since they do not so move it is impossible that there is a vacuum. "It is evident, then, from the velocity of motion that there is no vacuum."

13. *Bodies do not Occupy Anything Real*

But even aside from motion, a vacuum is "vacuous." When a block of wood is immersed in water the water recedes from that place. A vacuum must remain there coextensive with the block. "But if two magnitudes interpenetrate, it does not seem that they can be different. . . . It follows that the two bodies are (the same) one." But if they are still two, then any number of bodies can be in the same place!—"Place is not due to body by reason of matter, except in as far as matter is contained under dimensions. . . . But the vacant space has dimensions, too" (real dimensions according to the Adversaries). The dimensions

of the body suffice, without supposing a separate set of dimensions for the space it occupies.

14. *Bodies are not a Mixture of Matter and Vacua*

Some held that bodies are perforated with vacua, like a sponge, and this accounts for compression and expansion. Others held that not only are there these " separated " vacua (i.e. vacua and body in different spaces), but that vacuum and body interpenetrate, so that the two exist in the same space; and that this is what makes bodies light and compressible. Otherwise, when any body moved, it would push all the other bodies ahead of it, so that the outer heavens would bulge out. The same would happen when water was converted into air, the air taking up more room than the water. Or else as much air would have to be converted into water as would make room for the new air.

But there can be rarefaction and condensation without vacua. " The numerically same matter is in the contraries. . . . It is the matter of both the large and small." The same matter is in potency to the large and the small. " As matter is in potency to determinate forms, so also is it in potency to determinate quantity; hence rarefaction and condensation do not proceed to infinity."

When a body becomes hotter, it does so without converting cold parts into hot; when a circle is contracted, it acquires greater curvature without straight parts being made to curve; so also with the brightness of fire, etc. So, too, a body becomes larger or smaller without the addition or the extrusion of particles. Hence the dense body, containing the same matter in smaller compass, is " heavier."

Time

15. *What is Time?*

Anything composed of things that do not exist cannot be. But time is composed of past and future, both of which are not. Therefore time cannot be." Or, " For anything to be divisible, a part at least must exist. So if time is to be divisible, a part of it must exist. But the only thing that exists of time is the 'now,' and that is not a part, and it is indivisible." And does the same now persist, or are there successive nows? But there is no *next* now, so between any two nows there are infinite nows.

Since two nows are the termini of any finite stretch of time, between any two there are any number of nows. But cannot the *same* now endure? That won't do either, because one thing is prior to another only if it is in a different now; if the same now endures, everything is simultaneous.

16. *Time Associated with Motion*

"Some have said that time is the motion of the heavens; others that it is the celestial sphere itself." But a part of time is also time; yet a part of the rotation of the heavens is not a rotation. Besides there could be other heavens, so other times, independent of one another. The second opinion is too absurd to discuss; for, because everything is within the heavens locally and everything in time, it does not follow that the heavens are time. Besides all the part of the sphere are "simul," the parts of time are not. Nor is time *any* motion, because motion is either (alteration) in one subject, or (locomotion) in one place; but time is everywhere. Again, motion is fast or slow, but time is not; because time is the measure, and no measure is the measure of itself. Still time is not perceived without the perception of motion, as with the sleepers of Sardinia.

17. *Time a Derivative of Motion*

What is that "something" *of* motion, the "something" which is time? We perceive time when we perceive continuous motion, and when we are lost in our thoughts, "it suddenly occurs to us that some time has elapsed." Yet time is not particular motions, because there cannot be as many times as there are things moving. "Now, there is one first motion which is the cause of every other motion; whatever things are in a changing condition, have that from the first motion, which is the motion of the prime mobile. . . . Time follows only upon the one first motion, by which all others are caused and measured; and so there remains only the one time." Motion is continuous, but can be fast or slow; and its time is given by the amount of no other than that of the first motion. Extent is the reason for position (first, next, etc.); so, too, motion has prior and later. Yet, though the "before and after" are predicated of *motion* as the subject, they are derived from the extent or magnitude, which is *not* motion.

Then this spatial "before and after" becomes a temporal "before and after."

We designate in time two nows, yet such that we can put another now between them, just as in motion we can put another point between any designated two; in both cases there is a stretch between the extremes. If we concentrate on only *one* point, the present now, we do not get the concept of time. When we concentrate on the moving object, without regard to a *plurality* of its positions in the extent or field, we do not get the concept of motion. To perceive motion or time we must take account of *number*, i.e. of plurality: (1) of *cardinal* number, which means simply multitude and which is applicable to non-motion, i.e. to extension; (2) of *ordinal* number, which gives a determinate succession, a "before and after." It is motion that gives the seried order of numbers. Motion's "something" which time takes over is the ordinal numbers. "Motion is the actuation of an existent's potency." Time is *not* that. "Therefore it is evident that time is not motion, but takes over from motion the numbering (ordinal) which is peculiar to motion."

Number in the abstract (as two, three, four) is that *by* which we number. Time is not that. Again, an *actual* multitude is a set of discrete things, as ten men, ten horses. Extent in itself, as a bolt of cloth, is not actual (number) multitude; being a continuum, it is one. The same is true of motion; it is not an actual multitude. Extent and motion are not (actual) number, but they are *numerable*. What time does is to number actually the numerable, motion; just as the draper actually numbers the cloth when he measures it. The numbering is *applied* number in both cases; but the *order*, succession, direction, is determined in the time-measuring; it is not determined in the extent-measuring. That is because time is the measuring of motion, which is numerable, indeed, but numerable ordinally.

18. *The Moving Now is not the Measure*

As a moving point (pencil) or stone remains the same thing (subjecto), yet differs in reference to its path, so there is a *now* which does not change, except "accidentally." This now is "the terminus of the past and the beginning of the future. From this consideration the concept of eternity is easily got." To have motion at all, the moving object must remain the same, the same

that began to move. To substitute another mobile would break the continuity of the motion. But it has different *positions.* Therefore the one thing both continues the motion and distinguishes its past and future. But for time to be a measure, *two* nows must be taken. In measuring extent the *same* point may be taken *twice;* but in measuring things by time the same moving *now* cannot be taken twice. If the same now could be taken twice that would mean a rest, a stop, in time, as in motion.

19. *Time a Measure*

In the genus 'number,' *two* is the minimum. Two is a species of number, three another species, etc. One is unity, and unity is a transcendental; every number (as two, three, four, etc.) is an integer, an unbroken unit. In multitude there is a minimum number, but not in magnitude. In multitude the minimum number is two (though the minimum *in* number is one, that is, one is the minimum *constituent* of number). There is a minimum number, but no minimum size. So there can be one day or one hour, but no minimum interval of time, since time is a continuum, a magnitude. But time, being (number) measure, cannot be fast or slow; the *measured* is fast or slow. Every given *now* (an indicated terminus of a stretch of time) is simultaneous everywhere, but each now has a different respect to the past and the future; and so the nows themselves, in that they are arranged earlier and later, are different from one another. Motions may recur, as Spring, but the motion is not the same in number, only in kind (species). Yet since time measures motion, there is a parity between them; so "when the amount of motion is unknown, we measure the motion by time; contrariwise, when the motion is known and the time unknown," then we measure the time by the motion. From a known rate of motion (speed) we know how much time it takes to cover a certain distance.

20. *Time the Measure of Motion and of Rest*

Time measures a motion [e.g., that of an hourglass], then that *motion* is used to measure subsequent *time.* Motion accompanies time (simul) on the way. Things which are always, are timeless, as the ratio of the diagonal to a side. But things which are at rest are in time because there is enough time to exceed their term of rest. Now, though "the heavens always are (the same) sub-

stantially, they are not so in their *ubi.* Therefore their duration (esse) is not measured by time, but their local motion *is measured* by time." But " time is also the measure of rest. . . . For rest is not a negation of motion, but a privation of it. . . . Thus time is the measure of motion *per se,* and *per accidens* the measure of rest." And because time outlasts all corruptible things, it measures their substances, not as such, but their existence or duration.

21. *What " Then " means*

Two lines are contiguous when their end-points are together, and though they coalesce into one point, yet that point looks two ways; with respect to the left it is the end of one line; with respect to the right it is the beginning of the other line. The second line may be removed, and the point still remains; so, too, the first line, the point remaining. The point can be taken twice, separately. Not so the point of time which is called the now, strictly. In a broader sense the now may mean a stretch of time, as " today." So the terms " now " and " then " are the termini of any stretch of time; the " now " being nearer, the " then " more remote.

Aristotle held (Cf. Book VIII) that motion never began and will never end; each revolution of the heavens is of the same species but not the same in number. He argues that every " now " and every " then " is a *continuation;* it is a " between," and so must have a past and a future; hence time never began and will never cease. But this rests on the supposition that *motion* is sempiternal.

22. *Why Decay is Attributed to Time*

Motion is a *receding* from a given disposition, and so is allied to corruption; generation is the completion, finishing, perfection; " which perfection motion has from the intent of the agent . . . and generator." Since the corrupting-agent is usually more hidden (as in old age) than the generating agent, we are accustomed to ascribe corruption to time; but not generation.—From the fact that we speak of the same space covered in greater or less time, and of greater and less remoteness in the past and future, it is evident that " all motion is in time."

23. *Though there is no Time without Mind, there is only one Time*

If there were no (human) mind would there be time? This is similar to the question, If there were no senses would there be any sensibles? Now there is no numbering, unless there is a numberer. " If motion had a fixed existence in things, as a stone or a horse, it could be said absolutely that, even no soul existing, there is still a number of stones; so, likewise, there would be the enumeration of motion, which is time. But motion has not a fixed existence in things, nor is there anything *actu* in things in motion, except a certain indivisible of motion, which is motion's division (into ' before and after '); but the totality of the motion is got through the soul's consideration, comparing the prior disposition of the mobile to the later. So also time has no reality (esse) outside the soul (mind), except imperfectly."

Is there but one time for all? There is but one. For of all motions the simplest is local motion, and of local motions the more simple and regular is circular motion; " and among circular motions the most uniform and regular is the first motion, which revolves the whole firmament in diurnal motion. Hence that rotation, as the first and more simple and regular, is the measure of all motions. Regular motion must be the measure and number of the others, because every measure must be invariable (certissima); i. e., always the same. From this we can gather that if the first rotation measures every motion, and motion is measured by time, it is necessary to say that time is the numbering of the first rotation, by which time (itself) is measured, and by reference to which all other motions are measured, through the measurement that time gives them." Yet it is an error to say simply, " that the motion of the celestial sphere *is* time." Nor need we say that life goes in cycles because it is measured by cycles. The first motion (of the spheres) is the genus of all other motions, and so can be applied to them all, though they differ among themselves. This is only saying that *it* is the numberer, they are the numbered. And since any portion of the circle, as one twenty-fourth, can be said to be one hour, that spatial portion can be used to measure off the rest in hours, days, etc. This postulates that the first motion be uniform. That uniformity means equal space in equal time; thus " it is measured by time,

and is also that by which the time (of other things) is measured."

Book Five—SPECIES OF MOTION AND REST

1. *Essentials of Motion*

When what is said to move is only contingent to the moving object, it is motion per accidens; as when a *musician* walks. If a thing is said simply to move, when only a part moves, or is changed, it is motion per partes, or secundum partem. Primo (not part) et per se (not accident) is the motion that is to be divided into species. For example, when a physician heals, it is motion primo et per se. For motion are required: (1) mover (prime); (2) a mobile; (3) time; (4) terminus a quo; (5) terminus ad quem. The motion is in the subject, the mobile; and is denominated by the terminus ad quem; as corruption is motion toward non-esse, generation toward esse (i.e., the changing dispositions are *motion*). It is by this terminus that the species of motion is determined. — Time is not discussed here, "because time parallels motion as its extrinsic measure." But motion involves a mid-point, which can be considered as the contrary of either extreme (a quo and ad quem).

2. *Motion is from Positive to Positive*

Motion proper is but one species of mutation. Mutation is "from something to something . . . first this then that": (1) from a positive (subject) to a positive; (2) from a positive to a negative; (3) from a negative to a positive. (A fourth kind, from negative to negative, is rejected because negatives are not contraries, nor contradictories to one another.)

From a negative to a positive is generation. Generation secundum quid refers to accidents. But "that generation which is from non-esse simply to *ens*, which is *substance*, is generation simply, whereby we say simply that a thing becomes and does not become. The subject of substantial form is not an *ens* actually but only potentially; namely prime matter, which in the beginning of generation is under privation, but in the end under form; hence through generation of substance, something simply becomes." Corruption, secundum quid or simpliciter, is the reverse: from positive to negative.

But neither generation nor corruption " simpliciter " is motion; because both (simply) are termini, " non-ens " and " ens "; but a " non-ens " cannot move, nor come to rest; and if an " ens " change (without ceasing to be " ens ") there is only generation or corruption secundum quid. Consequently, motion is the first mentioned species of mutation: from positive to positive. Yet we must understand even the middle as contrary to the extremes; " because privation is in a way a contrary."

3. *Motion is not per se in the Categories of Substance, Relation, Action, Passion*

Motion supposes contraries, but substance has no contrary. Nor are substantial forms contrary to one another, though the properties they give rise to may by reason of " abundance or defect " be contrary; and prime matter may go from any form to any other.

Motion is not per se in the category Relation, because motion supposes that the *subject* changes; but in relation, there may be a change without the subject changing; namely if the term alone changes.

That motion cannot be in the agent (as such) is clear from Book Three. It is in the patient; the patient is the *subject*; but that subject cannot itself be *motion*; motion presupposes a subject and contrary terms. Likewise, there can be no " generation of generation," because such a series would be without beginning; for if each term is derived from two other terms, and each of them from two others, and so on, no generation could ever occur. " If there were generation of generation and mutation of mutation, nothing would ever become or change. It is to be noted however that this reasoning does not exclude the possibility of change following change in infinitum *per accidens*. This last must be admitted according to the opinion of Aristotle, who held eternal motion. But he intends to show, what he said previously, that there is no change *of* change *per se* in infinitum. For in that case the last would depend on infinite predecessors, and would never come to issue." Besides, the contrary to every motion is both another motion (opposite) and rest. But if generation were itself generated, it would be undergoing corruption at the same time. Generation (simpliciter) is the terminus, not

the subject; that is matter. But a term itself does not change. In short, there is no mutation of mutation except per accidens, as when a man's health improves while he studies.

4. *Motion is a Change of Quality, Size or Place*

It was already shown that motion is not quando, situs or habitus; and not substance, relation, action or passion. But motion is in quality, quantity and ubi; because in these last three there is the contrariety required by motion. In *quality*, motion is called alteration. "But we are now speaking of quality not as 'quale' is found in the genus of substance, whereby *substantial* difference is a qualifying predicate . . . but about the way a thing is said to be susceptible (pati) or not susceptible." In *quantity*, there is augmentation and diminution; i. e., from lesser size to the right (perfecta) size, or the reverse. In *Ubi*, there is the motion of "transfer" (latio); the contrariety arises from the direction of the motion. And nothing is said to "rest" except what is naturally fit (aptum natum) to move.

5. *Contact, Medium, Consecutive*

Things are in contact when their extremities are together. The medium is anything between the extremes; and in the case of local motion, the medium must lie on the path between the extremes. The consecutive, or next-following, admits of no intermediate pertaining to the order in which the things are consecutive. Consecutive quantities are not one continuum, because their termini are "simul," therefore distinct.

6. *Genus and Species of Motion*

In determining the genus and species of motion, we notice that "motion in one way is *reduced* to the genus of the things in which it is." But the species is determined by the term, and by the medium through which it passes; thus, although straight and curved paths arrive at the same point, they differ in species. For motion to be individual there must be: (1) no interruption, no pause for a time; (2) there must be no difference of genus or species, as alteration and local motion; (3) the immediate subject must remain the same. When there is a pause, the next motion, even though of the same species as the preceding, is a new individual motion.

7. *Individual Motion*

Motion is a continuum. Now, the extremity of a continuum is not twofold, nor multiple, but single (not "simul" but "unum"). Hence immediately consecutive motions, "consequenter se habentes et habiti," are not one motion. "There is nothing to prevent one motion from terminating in the same instant of time as another of a different species or genus begins; and so the motions will be consecutive but not continuous. Also, in the same species, if the subject change, as when a person hands a candle to another in a procession, the continuity is broken by the change of subject." Also, if there is an interval of "immobility or rest." Yet a motion may be quantitatively continuous even if prevented from reaching its perfect term, or form. Again uniform motion is more one than irregular motion, because the uniform has a similitude in all its parts. A straight motion keeps the same direction uniformly, a circular motion varies the direction uniformly; zig-zag motion does neither. Besides, a motion may be irregular or regular in its *velocity*; yet it is one motion. "Fast and slow" do not constitute species, because they are found in all species. "Irregular motion can be said to be one motion, in that it is continuous; but it is denominated *less* one than regular motion; a line making an angle is less one than a straight line. This is especially apparent in reversed motion; because it seems as though there were two motions."

8. *Contrary Motions*

Motion gets its species from the category it belongs to, but is further specified by its terminus ad quem. Thus the motion toward health is opposite to the motion toward illness. Likewise local motion in opposite directions. But for motion, both terms must be positive ("affirmatos"). A change from a mere negative to a positive, or the reverse, is not motion but mutation. This latter is the case in generation and corruption; and the opposition here is had in the approach to or the retreat from the terminus ad quem, the form. [This "accessus" or "recessus" is in the dispositions, not in the form itself.] But even in motion which stops at a medium position between two natural contraries, as white and black, the medium can be considered as contrary

to either of the extremes; for this medium is positive, and not a mere negation.

9. *The Opposition of Rest and Motion*

As motions toward opposite terms are opposite motions, so rest in one term is opposed to rest in the other. But rest is not opposed to *all* motion. Rest in a term is opposed to the motion *away* from it (toward the other term), but is not opposed to the motion *toward* its own term; because a motion's stoppage in its term (ad quem) is the motion's satiation (quietatio), its fulfillment or perfection, rather than something opposed to the motion. To move to a term is to "become rest"—"fieri quietem." But rest in one species is not opposed to rest in another species, because opposites must be in the same species.

In those mutations where there are no positive opposites (i. e., in generation and corruption), there is, instead of "rest," rather a non-mutation, "immutation"; because rest is the complement of *motion*, and there is no motion in generation and corruption, strictly speaking. Yet the mutation "ad esse" (generation) is opposite to the mutation "ex esse" (corruption). Now, "non-esse" may have as a subject: (1) an "*ens actu*," as non-album has as its subject a complete substance; or (2) an "*in potentia tantum ens*," i.e. the privation of substantial form has, as its subject, prime matter, an incomplete substance. Or it may have no subject, and is sheer non-ens. "If it have a subject, then it is possible to discover how one non-mutatio is the opposite of the other non-mutatio; because it can be said that the non-mutatio which is in the esse (the non-mutation of the substantial form) is opposed to the non-mutation which is in the non-esse (the non-mutation of privation). For from the fact that it has a subject, nothing prevents our saying that that subject may *persist* in that non-esse, that is, that it does not change. . . . And because to the non-mutatio or quies which is in the esse (the form) there must be some contrary non-mutatio, it becomes evident that that non-esse *from* which generation is and *toward* which corruption tends is a non-esse having a subject." The immutation of the form would have *no* contrary immutation unless the privation had a subject; but since it has a subject, these two immutations can be opposite to one another, as rest is opposed to another rest. In another way the immutation of the form is opposed to the corruption which *recedes* from that immutation.

10. *Answers to Difficulties*

Growth is a natural movement, decay is due to deficiency or weakness of nature. A natural principle of motion is internal; if the principle is external, the motion is "violent." So the artificial growing of flowers in winter, or even the generation of tadpoles (by the influence of the sun) is called "violent," as opposed to natural generation. So, violent corruption may be opposed to natural, and generation likewise; but that does not prevent generation from being opposed to corruption; nor meliorative ("dulcis") generation from being opposed to pejorative ("tristis"), as fire from air, and the reverse; "because corruption is opposed to generation in the whole sweep of its genus." So, too, up and down are contraries, whether the motion be natural or violent; and a motion which is natural to one element is violent to another; and so also the "rests."

"The *coming* to rest (stare) is the *generation* of rest." But for it to be true generation the velocity must be increased as it approaches its term (form). In violent motion the velocity decreases; "therefore violent rest is not generated."

Rest in either terminus is somewhat mixed with the motion to and from it; so rests are *less* contrary than the motions, for the motion is either in one direction or the other without any admixture.—The remainder of this Chapter [says St. Thomas] is not the work of Aristotle but of some commentator, perhaps Theophrastus; and it is scarcely more than a repetition of what had already been said.

Book Six—PROPERTIES OF MOTION AND TIME

1. *A Continuum Admits of no Indivisibles*

The termini of a continuum are single (unum); the termini of contiguous quantities are plural but together (simul). So a line is not composed of points; neither by way of continuation nor by way of contact. (a) Not by continuation, because an ultimate implies something else *of* which it is the ultimate; but in a point there cannot be something else. And, since there is nothing but the point, there is no continuation. (b) Not by contact; because, though the points be "simul," the new point adds nothing, unless something *besides* the point is added. Nor can mere points in contact form a continuum, because a part of one point

cannot be in contact with a part of another; they are both in the same place or position; but a continuum is "divided into parts different and distinct in position." Neither can a continuum be composed of indivisibles in sequence (consequenter), whether the indivisibles be points or "nows"; because two things are in (immediate) sequence, only if there is no medium of the same order between them; but between any two points there is a line. And the line is divisible into lines, the time into times. The medium *must* be divisible; because if the medium be indivisible, it cannot be in contact with the other indivisibles. If the medium be divisible yet divisible into indivisibles, the same difficulty returns. The conclusion is that the medium must always be divisible into divisibles, never into indivisibles.

2. *Motion a Continuum*

"If magnitude is composed of indivisibles, then one motion which passes through the indivisibles will be composed of indivisible motions equal in number to the indivisibles of which the magnitude is composed. . . . To each part of the magnitude there corresponds a single part of the motion." Hence the whole motion would be made up of indivisible constituents ("momentis"). But that would mean that a thing had finished moving (motum esse) without ever having moved. For in each point of the magnitude it would not be moving but at rest; "but what is at rest in each part is at rest in the total; it would always be moving and always resting, which is altogether impossible. . . . There would be motion present without anything moving." Motion is not composed of non-motions.

3. *Time a Continuum*

As magnitude and motion are infinitely divisible, so is time. For uniform velocity means equal distances in equal times, but it also means lesser distances in lesser times. Therefore time is as divisible as magnitude. Also a faster motion will move farther than a slower, in any given fraction of the time. Hence, just as magnitude is divisible only into magnitudes, so time is divisible only into times.

Objection: The above argument supposes that "for every moving thing there is a faster and a slower. But that proposition seems to be false. There are fixed velocities of motions in nature.

There is in fact a motion so fast that none can be faster, namely the motion of the prime mobile." Answer: "We can speak about the nature of a thing in two ways: either about its general nature, or about its application to a given matter. And what is true of the first may not be true of the second. Thus there is nothing in the nature of the form of the Sun to prevent there being other suns, but only because the whole matter of the species is contained under the one Sun. In the same way the general nature of motion does not exclude a greater velocity than any given velocity; that is excluded only by the determinate powers of the movers and the moved." Here Aristotle is speaking of the general notion, not about its application to the de facto motions of the universe. "In like manner it is not against the nature of magnitude that any magnitude be divided into lesser magnitudes. . . . Yet, in applying magnitude to a determinate nature, there is a minimum magnitude, because every nature requires a determinate greatest and smallest, as was noted in Book One."

Since, then, for every speed there is a faster and a slower possible, it follows that time is always divisible into further divisibles, just as magnitude is. And the same is evident from uniform velocity, because it covers equal spaces in equal time, and half such space in half the time, and so on without end.

4. *Infinites*

"Time and magnitude are such that, given one of them infinite, the other is so, too, and in the same way." This infinite is of two sorts: (1) without a terminus, as a line need not stop at a point nor time at the present; (2) infinitely divisible, as the continuum. Zeno, the Eleatic, said that since there are infinite intermediate points in any given distance, and since one cannot touch that many points is finite time, one cannot really move at all. We answer that an infinite distance (infinite 1.) cannot be traversed in finite time; but an infinitely divisible stretch (infinite 2.) can be. Because, if you want to argue that way, there are infinite nows in the time just as there are infinite points in the space. That, however, is only an argumentum ad hominem. Viewing the matter itself, we can say: "No moving thing can cover an infinite space in finite time, nor take infinite time to cover a finite space." In the second case, however short a distance it move in a given time, that distance if multiplied a suffi-

cient (and finite) number of times will equal, or even exceed, the finitely long distance to be covered. If you quibble that a thing taking infinite time to cover the distance would also take infinite time to cover any *part*, then we counter by supposing *another* path of shorter length than the first, which other path it must cover in less time than the first; but less than the infinite is finite. So, too, in the first case, the motion can cover only a *part* in finite time; therefore it cannot cover the infinitely long in finite time.

"From this it follows that neither line, nor plane nor any continuum whatever is an 'atom,' that is indivisible." For, suppose a length made up of three indivisibles, and another made up of six. Then suppose that while one motion makes the transit of the three, another motion makes the transit of the six. The indivisibles of the second would have to split each of the other indivisibles into two! "So it is clear that no continuum can be indivisible."

5. *Both Motion and Rest require Time*

Of itself, the now is the point between the past and the future. But the end of the past and the beginning of the future is *one* point. If there were two consecutive points that would mean that time is an aggregate of nows; which it cannot be, as it is a continuum. Nor could the two nows have an interval between them, for the interval would be an intermediate time. There can be no such time, because the "future follows immediately upon the past." Besides, "the division of a *continuum* is nothing else than the common terminus of two parts; and that is what we understand by the now, that it is the common terminus of the past and the future." So a divisible interval could never be the now itself. And if divisible, it would be divided into a past and a future, neither of which it can be identified with. The only way out is that the now is indivisible.

For that reason there can be no motion in the now; nor can there be rest, because "rest is the *privation* of motion"; and since nothing can move in the now, nothing can be deprived of motion in the now. And, as was said above, "every extreme is *in* that of which it is the extreme, as a point in a line; the total now must be in the past time as its end, and in the future time as its beginning." So, "the same now is in two times. Through-

out one of these times a thing rests, throughout the other it moves." Again, to move is to be different than previously; but "ly prius" belongs to the past, not to the now. "Hence, everything that moves and everything that rests must move and rest in time."

Aristotle next "shows that everything which moves is itself divisible." For if it is totally in the terminus a quo, it has not yet begun to move; if it is totally in the next terminus ad quem, it has ceased moving. So, to be moving, it must be partly in one terminus and partly in the other, which means that it itself is divisible. Averroes cites Alexander and Themistius as holding that this cannot cover the case of substantial change, where the subject is divisible but the change is in non-time. Yet it does cover that case. For "in those changes between whose termini there is nothing else intermediate, that which is changing is not partly in the two extremes considered in themselves, but it *is* so by reason of something concomitant to it. Thus when prime matter is changing from privation to the form of fire, while it is in the very process of changing (in ipso mutari) it is indeed, considered in itself, under privation, yet is partly under the form of fire, not because of itself but because of something concomitant to it, namely fire's proper disposition which it partly receives before it has the form of fire. Hence Aristotle will show, further on, that even generation and corruption are divisible; because what is generated was previously *being* generated, and what is corrupted was previously *being* corrupted."

But does this principle hold true of alteration? It must be said that it is *primarily* true of local motion. Yet, because the influence of the altering agent gradually spreads through the affected body, it is true in a sense (aliqualiter) of alteration. Aristotle is here speaking of quantitative parts, not merely of greater or lesser qualitative participation. And when he speaks of a terminus being the next ad quem, he means a place as large as the body and adequately distinct from the place a quo; intermediate overlapping positions are to be disregarded, because, since they mount up "in infinitum," to take account of them would render the description of motion impossible. The "next" must be distinct, as species is distinct. "Similarly, in the motion of alteration the next *to* which the thing changes must be understood to be a medium of a different species (dif-

ferent from the terminus a quo); so, while it changes from white to black, the medium must be taken to be gray, not as merely less white."

6. *Every Mobile is Divisible*

In the previous number, parts were assigned to motion according to the successive moments of time in which the moving object was in successive places. In this *Lectio* (6) we note that each *part* of the *mobile* can be assigned a motion of its own. As it moves from one region to another, the first half of the body arrives at a place *before* the second half does. In assigning divisions by *time,* we suppose the whole body to be simultaneously in a place; in assigning divisions by the *parts* of the mobile, we see that the parts arrive successively. This second way of dividing motion is due to the mobile being an extended object; it could not be used if the mobile were a point.

There are five quantities which can be divided (measured): 1. the time; 2. the past motion; 3. the coming motion, "ipsum moveri"; 4. the moving object; 5. the scope, or extent, "id in quo." The last is subdivided into place, quality and quantity (augmentation, diminution). All these five correspond to one another in their totality and their parts, and all are infinitely divisible.

7. *No Instantaneous Motion*

To be changing is to be departing from a term, whether that term remain, as in local motion, or perish, as in alteration. To have been changed is to have (completely) departed. "But change is better designated by the terminus ad quem. . . . In the change which is between contradictories (strict generation and corruption) the thing changed is *in* that to which it was changed. And if that is true of this change, it is true for a like reason of the other changes." When a thing stops changing it is already changed; and it cannot stop except in an indivisible instant. "Everything that has been destroyed and everything that has been made was made and destroyed in an indivisible instant of time; because generation and corruption are the *termini* of alteration. Hence, if *every* motion terminates in an instant . . . it follows that generation and corruption are in an instant. . . . This means that the mutation is completed (perfecta) and terminated."

When a thing is stopped it is no longer changing. Before it starts, it is not yet changing. But there is no such thing as the *first* part of change; for if that part is a *stretch* of time, it can be divided into fractions of which there are always earlier and earlier; if it is an indivisible instant, no change can take place in it. (This does not mean that when a body is passing a marker, "signum," there will not be a first part go by; it means that we must take the motion as a whole.) One might object that on the score of the mobile itself there is *instantaneous* change, as turning white. "For white is not divisible in itself, but both it and all other things of that kind are divisible per accidens, in as much as that in which the white, or any other quality, inheres (accidit), is divisible. . . . One way is by quantitative parts; thus if a white surface is divided into two parts, the white will be divided per accidens. The other way is by intensity or weakness; for the fact that one and the same part is more white or less so, does not come from the nature of whiteness; if it were whiteness by itself (separata) it would not be denominated more or less such (just as substance does not admit of more or less); but the more or less comes from the different degree of participating in whiteness on the part of the divisible subject." But motion proper is divisible per se. "Only in qualitative change does it happen that there is anything indivisible in itself," i.e. the quality by itself.

8. *"Being Changed" must Precede "Changed"*

Motion is prior to having-been-moved. "Because while the moving object is in motion toward a term, it has already passed a point (signum) in respect to which it has-been-moved (mutatum esse). But as a point *within* a line is in potency before the division of the line, in act however when the line is already divided, since the point is the very division of the line; so what I mean by having-been-moved, within the motion is in potency when the motion is not stopped there; but if it is stopped there, it is in act. And because what is in act is better known than what is in potency, for that reason Aristotle proved that what continues to be moved is something already moved—proved it by another mobile, of equal velocity, which did stop there. It is as if one proved that there is a point in potency in a line, by the fact that another line of the same kind is actually divided there.

The same is true of the time that measures the motion. Having-been-moved is the terminus of the motion, but a terminus requires previous motion. Therefore before the 'moved' there must be motion." Motion then requires two "nows" with time between them. But does not this exclude generation and corruption, which are from non-ens to ens, and conversely? Surely there cannot be a stretch of time when the changing subject is *neither* of these. Answer: "If generation is understood as the beginning of the existent as such (essendi) together with the whole preceding motion (alteration), taken thus it is not in an instant but in time; so that in the whole preceding time that which is being generated is a non-ens, and in the ultimate instant it is an ens. And the same is to be said of corruption."

The proposition that motion must precede the moved can be proved about *alteration,* not by an appeal to the divisibility of magnitude, but only to that of *time.* It follows that there is no first part in motion, as there is no first part in a line. But it does not follow that the motion, or the line, is infinite; "because, before the first *indivisible* of motion there is not any part of the motion. That first indivisible, however, is not denominated 'moved,' as neither is the first point of a line denominated 'division'."

In generation the "mutatum" is the substantial form, the "mutari" is the alteration, the gradual acquisition of a quality. "Alteration itself, because it has two termini (to which), namely substantial form *and* the quality, is called by both names, alteration and generation." But generation proper (like intellection, perception, lighting) is the terminus of a motion. And when it is called "mutatum," we are not to understand that the form *itself* (as happens in dispositions, qualities) was undergoing change up to that point, then stopped.

9. *Relation of Space, Time, Motion*

Aristotle here repeats the thesis that any finite space will be crossed in finite time by any motion, uniform or irregular, provided the motion does not double back as in circular motion, but continues always forward. Nor can any motion cross an infinite space in finite time. Of this last, the converse is that an infinitely long body cannot pass a finite stretch in finite time. That this is the converse St. Thomas shows by saying (mod-

ernly): "If the infinitely long moving body cross a finite stretch, it follows that a finite mobile (the given stretch) must cross the infinite length. Since, as the mobile, so the space is a quantity; then, given both quantities, it makes no difference which of them moves and which rests. . . . As the mobile passes the space, so the space passes the mobile."

10. *Stopping*

All coming-to-a-stop (statio), whether fast or slow, occurs in time; and as there is no first part of motion, so there is no first part of tending to rest. Neither is there a first in rest itself; because a thing cannot rest for an indivisible instant, it must rest for an interval of time; but an interval is a continuum, and there is no first part of a continuum. To rest is to be in one and the same place or disposition for some length of time, but not for an indivisible now. "And whatever moves, so long as it moves, is never in the same state for two nows, but only for one." Thus, between any two given places there are infinite places, as there are "infinite grades of white and black and intermediate colors"—not infinite in act, but in potency.

11. *Zeno's Difficulties*

Zeno: In any and every now the arrow is in one determinate place; but what is in a determinate place does not move. Answer: I deny the supposition that time is made up of indivisible nows. Zeno: To move across a space one must first cross the half; and before that, the half of that; and so on to infinity; but one cannot cross an infinite number in finite time. Answer: This supposes extensive magnitude to be composed of actual points; but there are no actual points, except the actual beginning or end of a stretch; a point is actual only if the motion stop there—"ibi stet." And the same reply disposes of the "Achilles" difficulty. Zeno: Two objects (e.g., chariots) moving at equal speed but in opposite directions pass each other at twice that speed, i.e. in half the time; therefore a half equals the whole. Answer: The first named speed is rated with reference to something at rest, the second to something moving. Zeno: A train of four bodies [cars] is standing; a similar train is moving past it; a third train is also moving opposite to the second. The moving trains have doubled the speed with respect to one an-

other. Answer: "Zeno makes the same mistake as before. He supposes that the third train C ought to take the same time to pass the opposite-moving B as it takes to pass the standing train A." Zeno: When a thing is changing from white to not-white it is between the two termini, and so is neither white nor not-white. Answer: This was treated above (*Lectio* 8, this Book), and will be treated more fully in Book Eight. Zeno: A sphere rotating on its axis does not change its place; but what does not change its place does not move. Answer: All the *parts* change their place; therefore the whole sphere moves, as a wheel or a shaft moves.

12. *Can a Point Move?*

An indivisible does not move. We mean quantitatively indivisible; not indivisible in species, as an element "cannot be resolved into a plurality of bodies differing in species." Nor do we mean that a point on a surface cannot move with the surface. Such a point moves per accidens. Can it move per se, by itself? No; because a point must be totally in the term a quo or in the term ad quem (in which cases it is not moving); and it cannot be partly in one term and partly in the other, because it is indivisible. The only way a point could move would be on the supposition that time is made up of nows, space of points and motion of instants; but that is impossible.

13. *Can Motion be Endless?*

"Every mutation is from something to something." *Generation* is from non-esse to esse, *corruption* from esse to non-esse; alteration is from one extreme to the other; "the terminus of *growth* is the perfect size. I say 'perfect' according to the requirement of the thing's own nature, for a different perfection of size pertains to a man and to a horse. The terminus of *diminution* is whatever happens, in such a nature, to be most remote from the perfect magnitude." In every case there is a term. But not all *local motion* is between contraries; as in the case of earth and fire, whose regions are contrary simply. We cannot suppose such limits for voluntary or violent motion. Yet local motion cannot cross the infinite; for that is impossible; and nothing can tend to the impossible. Hence no motion can be endless. Circular motion is not endless in its course, since it returns to the beginning. But can it be endless in time? "Circular motion

can continue, one and uninterrupted, for infinite time, as will be shown in Book Eight."

Book Seven—MOVED AND MOVERS

1. *The Question Delimited*

"Everything which is being moved is being moved by something else." This is true not only of compulsory (violent) motion, but of natural motion, too; even of living things, where part moves part, and the soul moves the total. Speaking universally, every mobile is divisible (Book Six, L. 6); hence there is no "first part." And to discuss the question, we must take the mobile *per se*; not per accidens (as white moves), nor by part (as one part of an animal moves while another does not); but the subject of which the motion is directly (per se) predicated. Also, we must understand adequate motion, where the subject passes completely out of the terminus a quo into the next terminus ad quem. Failure to note these specifications caused difficulties for Galen, Avicenna and Averroes. Plato, in saying that only spiritual substances move themselves, means motion as the actuation of an already completed being (actus perfecti). Thus, Aristotle, too, calls intellection (of first principles) and perception "motion." But he is *here* speaking of motion as the actuation of an as yet incomplete thing.

2. *Application to Local Motion*

"From the principle that whatever is being moved is being moved by another, it follows that the same must be true of *local* motion." It also leads to the conclusion that there must be a first unmoved mover. For "If the mover itself is being moved, it must be being moved by another. Now this cannot go on to infinity, but must end somewhere." And these motions are not in temporal sequence, but simultaneous, in an ascending scale ("ascendendo"). Nor is it sufficient to say that in a universe of infinite extent the motions of an infinite number of bodies would sum up to infinite motion in finite time. One thing indeed cannot have infinite motion in finite time, but an infinite number of things could. The point is that the ascending series, of moved and movers, moves as a single unit or system. Hence, in a uni-

verse of infinite extent, whether composed of one body or infinitely many, a single unit would accomplish infinite motion in any finite interval of time, however short. But that is impossible; therefore the ascending series must be finite; that is, there must be a *first* mover, not moved by another.

3. *Motion by Contact*

The immediate mover (efficient, not final, cause) must be in contact with the moved. Though this is true also of qualitative and quantitative motion it is most evident in local motion. When a part (as a foot) moves other parts, there is contact. When the bodies are distinct, there are four sorts of moving. 1. *Pushing:* (a) when the bodies stay in contact; (b) when the pushed body moves on after contact is broken. 2. *Carrying:* when a thing is moved per accidens, i. e. with the motion of another, as a man on horseback; no matter how many things are moving per accidens, we must eventually come to one which moves per se. 3. *Pulling:* "In pushing the mover serves as the terminus a quo; in *pulling*, as the terminus ad quem." (a) The "finis" pulls; "in this way a place pulls that which naturally moves to the place." (b) A thing may pull another by changing it; e. g., a magnet. "Just as the generator moves the light and heavy, in that it gives them a form by which they are moved to a place; so the magnet gives the iron a quality by which it is moved to the magnet." (c) The pulling of which we speak here is had when the mover remains conjoined to the moved, without altering the moved, even when it is being moved in the direction of its natural motion; though, of course, faster than the natural motion. Compulsory pullers move the moved to themselves; voluntary, to themselves or to another. Breathing, uniting and dispersion, etc. are examples of attraction and repulsion; which two sum up all local motion. 4. "*Turning* is a motion compounded of pull and push; for when anything is turned, it is pushed in one direction [along the tangent] and pulled in another [along the normal]." A projectile is in contact with the propellant at the beginning, but only so long as its natural motion is being accelerated; after that the only force aiding its momentum in penetrating the medium is the air closing in at the back of the projectile. (Cf. Book VIII, L. 22).

4. *No Alteration at a Distance.*

As pushing and pulling are not action at a distance, so neither is *alteration.* The Sun warms the air without warming the planetary orbits in between, though it lights them; but that is because " recipients receive in their own manner the action of agents.... All alteration is like that which occurs in sensation." Sensible qualities " are called ' impressions ' (passiones) because they make an impression on the senses. . . . To be altered by these qualities is a property of all sensible bodies, both animate and inanimate. . . . For the senses have no action except through a bodily organ; and it belongs to body to move and undergo alteration; hence passivity and alteration are more properly said to be in *sense* than in intellection." Inanimate bodies are unaware of the alteration; sensitive bodies, in their sensitive parts, are aware of the alteration. But the agent, as in sound and touch, is in immediate contact with the sense organ. And that holds for all altering agents. Even in the case of sight, " the surface of the visible body is in contact with the illuminated air, which terminates in vision." Likewise, *growth* and *diminution* are by addition and subtraction, which cannot occur without contact of the agent.

5. *Figure and Form not Subject to Change*

"All things that are altered, are altered in sensible qualities; especially in form and figure and in habit and dispositions. . . . Figure is what is inclosed within a boundary or boundaries. But form is said to be that which gives a specific esse to an artifact. The forms of artifacts are accidents." But form and figure do not of themselves change; shape itself does not change, but things change from one shape to another. " It is ridiculous to say that a horse *changes* when it acquires walls and a roof. . . . Everything is completed (perficitur) and made, in that it receives its proper form and figure. There is therefore no alteration in the very reception of figure and form. To make this clear we have to consider that among all the qualities, figures especially follow upon and indicate the *species* of things. This is especially evident in plants and animals. In these there is no more certain test of the diversity of species than the diversity of figures. This is so because, of all accidents, just as quantity is

most closely allied to substance, so figure, which is a quality of quantity, is most closely allied to the form of the substance." Matter changes its form and figure, but these do not change; nor is the very acquisition of these an alteration. And the same is to be said of the first species of qualities, i.e. habits and disposition; they are not changed primo et per se; " their transmutation follows upon some prior alteration, as hot or cold, etc." In themselves they are not relations, but they have a relation to the proper end of the thing in which they are, " which end is an activity." These " very relations begin to exist as a *consequence* of certain motions."

6. *Habits not Subjects of Alteration*

As the habits of bodies, so the habits of the *soul* do not in and of themselves (primo et per se) undergo alteration. " Virtue is the sign of the *completion* of a nature. . . . But nothing is said to be undergoing alteration after it is perfected; nor likewise after it is corrupted. . . . As form and figure are not processes, so neither are virtue and vice such." The Stoics said virtue is the removal of passions; Aristotle, that it is the control of passions; either way, the change occurs in the passions, not in virtue or vice. Again, the virtuous and the vicious delight in opposite things; but " pleasure and pain are in the sensitive part of man, in which alteration occurs. So the acquisition and loss of moral virtue is consequent on an alteration. . . . Intellectual virtue, too, has its pleasure but that pleasure is not in sense; hence it neither has a contrary nor is it subject to alteration, except metaphorically."

Intellectual knowledge, as a habit, does not undergo alteration. " He proves it thus. In no other category does it happen that something new comes to a thing without changing it, except in Relation. One thing, for instance, becomes equal to another when only that other changes." Habit is a power to act; " this act does not bespeak the generation of its active principle, rather it bespeaks something proceeding *from* the active principle; hence understanding in itself is not generation or alteration." In the young and the ill-disposed there is a perturbation in the sensitive region, which has only to cease or be mitigated, in order that the habit of knowledge perform its function. (This is a somewhat Platonic view of knowledge, but Aristotle has not yet expounded

his own theory, in III *De Anima*, so he discusses it no further here). Aristotle's theory is saved by the following consideration. "A receptive subject can be related to the form in three ways." 1. It may be in the ultimate disposition without any impediment; " then at the presence of the active agent, it receives the form without any further alteration; as is evident in the air illuminated at the presence of the Sun." 2. It is not in the ultimate disposition; " then of itself (per se) alteration is required by which the matter acquires the disposition proper to the form; as when fire is generated from air." 3. It is in the ultimate disposition, but there is an impediment; as the reception of light is prevented by a closed shutter; " then alteration or mutation is required per accidens, to remove the obstacle. Accordingly, the possible intellect is, considered in itself, always in the ultimate disposition for receiving the intelligible species. If therefore there is no impediment, immediately at the presence of the objects received through perception (experimentum), there comes to it the intelligible species, as the mirrored form to the mirror at the presence of a body. This is why he said that knowledge is a relation. However, if there is an impediment, as happens in children, this impediment must be removed for the intelligible species to be received in the intellect. And so, per accidens, alteration is necessary."

7. *Univocal Measurement*

Not all motions are measurable by one another. " No quality (passio) is equal to a length "; quality and quantity are different categories. But circular and rectilinear motion are in the same category. Are they measurable (comparabiles) by one another? The lines " are not coincident, so as to be said to be equal." We answer: Take a straight line which is evidently shorter than the circumference of a given circle. Let a motion cover the line in the same time as another motion covers the circumference. The first motion is slower; and slower for every fraction of the distance. So, half the line is comparable to half the circumference, and so on. It follows that, by their *time*, the linear paths are measurable by one another.

We cannot, of course, use one measure for things that are equivocal; as a sharp pen, a sharp wine, a sharp tone. Even an " equal " amount of air and water is equivocal, because of their

different densities. "It is to be noted that many things in the abstract consideration of logic or mathematics are univocal, which in the concrete application of the physicist are somewhat equivocal; because they are not applicable in the same sense to every subject-matter." If the immediate subject is the same the application is univocal; as a white horse and a white dog (where the immediate subject is the hide); or the horse is *larger* ("because there is the same subject of magnitude; namely, the substance of the compound—corporis mixti"). But we cannot say that there is a greater volume of water than volume of voice; because the subject of one is substance, while that of the other is a quality, sound. Yet we cannot admit that the only difference is in the matter, as Plato contended; for then "everything would have the same nature"; as white, sweet, etc. Plato demanded oneness on the part of the form, diversity on the part of the matter; so that the whole reason for diversity came from the material principle. Hence he made one and existent (unum et ens), univocal, meaning one nature; and the diversity of natural species due to the diversity of the receptive subject. Yet not any subject is receptive of any form. Forms differ, and they give the species. True comparison, measurement, must remain within the species.

8. *Analogous Measurement*

Local motion is a genus which gets its species from the path (straight, curved). Genus, as "animal," has no soul; "genus is one logically, not physically." But is "body" a genus for the heavens and sublunary things? "If 'body' is predicated of a celestial body and a corruptible body, it is predicated equivocally (by 'proximate equivocation,' i.e. analogously) physically speaking, because their matter is not one (the same kind); but they agree in logical genus, and because of that agreement they are seen to be not altogether equivocal." Only species (not genus) has a real determining form. Comparisons must be made within the species; as equal velocities along the same kind of line.

In comparing *qualitative changes* (alterations) we use *time* as the measure, and similitudes as the termini—not points, as in magnitude. But we must keep within the same species. Yet there may be a sameness of quality, though the quantitative *area* of the subjects affected be different. Also in generation and

corruption comparisons must be confined within the same species; only we must note that there are no various degrees, as in qualities; there is no generation (strictly) until the process leading to it is completed.

9. *Factors of Motion*

When a body is moved, its velocity varies in direct proportion to the force applied; or, granted the *same* force, in inverse proportion to the mass of the body; that is, provided the force, or strain, moves it at all. Zeno said that if a bushel of millet makes a noise when dropped to the ground, then one grain of millet should also make a noise. Aristotle: perhaps the impact of one grain cannot move the air at all, and so can cause no sound. Besides, " a part in a total is not in act, but in potency, especially in continua. As a thing is ens, so it is one. But one is what is undivided in itself, and divided from others. A part however as it is in the total is not divided in act but only in potency; hence it is not actually an entity (ens) nor a one, but in potency only. For that reason the part does not act, but the total." If movers are geared to a certain speed, the addition of movers will not increase the speed at which they move a body. This is analogous to the continuum, where all the parts move at the same speed. In every motion (local, quantitative, qualitative) there are four factors for velocity: the agent, the patient, the time, the amount.

Book Eight—THE PRIME MOVER

1. *All Motion, Eternal or not, Requires a Mover*

The question here is not, as Averroes (Commentator) says, whether the motion of the first sphere is eternal, but whether motion in general " always was and always will be." The *fact* of motion is presupposed by physics. Opinions of philosophers: Democritus said there always was motion, and in an infinite number of worlds in space; Anaxagoras, world order began without ever having been before, and so motion too began; Empedocles, a succession of motion and rest throughout the world. Aristotle is in quest here (and in XII *Metaph.*) of the first principle of motion. He proves that principle to be one, and does so on the most extreme supposition, *viz.*, the eternity of motion. " This way of proving the first principle is most conclusive and

cannot be contested. For if, the world and motion existing sempiternally, it is yet necessary to demand one first principle, much more so is it necessary, if their sempiternity is denied. Because it is clear that every new thing requires an innovating principle. Therefore the only way it could have seemed unnecessary to demand a first principle, was on the supposition that things are from eternity. If, then, even on this supposition, it still follows that there is a first principle, it is shown absolutely that a first principle is necessary."

2. *Whether Eternal or Not, the World is Created*

Every real motion requires a real subject, and the subject is prior by nature to the motion. This does not exclude creation, as Averroes surmises, because creation is not motion, not change; it is "a simple springing up (emanatio)." Aristotle himself and many Platonists held "the production of things by God from eternity; whereby it is not necessary, nay it is impossible, to presuppose for this universal production a non-produced *subject*." It is equally as impossible for creation from eternity as it is for creation in time. "If a particular entity is generated, it is not generated from altogether non-entity; but if the total entity is produced, i.e. produced to the whole extent of its entity (fieri ens in quantum ens), it must be produced from complete non-existence."

To suppose the world *motionless* for an eternity before motion began "seems irrational"; because a world of mobiles without motion would be at total rest; but rest is a privation of motion, and the privation needs a cause. To start the "first" motion, that cause must be removed; but the removal would require a previous motion; and so on ad infinitum. Whether removing an obstacle or putting things in the proper disposition be required, motion is necessary in either case. Besides, says Aristotle, "the 'now' is an intermediate . . . the beginning of future time and the end of the past." Therefore there is no first point of time.—But here Aristotle *supposes what he sets out to prove;* for the "now" is not always the *end* of previous time, *unless* time is infinite. And there is no more repugnance in a "now" being a beginning only and not an end, than in a point being the beginning of a line.—And motion will never end, since time never will;

since for motion to end, the very mobile must be destroyed; and it takes a further motion to do that.

There is nothing in all this against creation, because these arguments suppose motion of natural origin, " per viam naturae." Whereas, creation, whether from eternity or in time, is not motion at all. Yet the First Mover is eternal. If you say that then God must change when He produces the world, the answer is that He produces it by His will, where motion does not occur. " He can by an eternal will produce a non-eternal effect, just as by His eternal intellect He can understand a non-eternal thing." If you ask, Why did God wait? your question supposes God to be in time, whereas He is not, but produced both time and the things in time. But why did He not create a world without a beginning in time? Only God's wisdom knows the answer, but we can say that a temporal world helps us to realize that God does not need the world and is all-sufficient to Himself.

When we speak of time before the world began we mean imaginary time, just as when we speak of place outside the world, we mean imaginary place. " There is however before time a certain duration, namely the eternity of God."

3. *God is the Reason why Things are Possible and Why They Exist*

Anaxagoras said that the world remained motionless for an eternity then began to move, and would continue moving forever. He did not state the reason why it should be in the nature of things to rest infinitely, then move infinitely. In fact, that could not be in any nature; nature is order, and there is no order between two infinites. Similarly Empedocles does not establish his axiom (dignitatem) that friendship (rest) and strife (motion) must follow one another, and that eternally.

But the fact that a thing always is (semper est) does not mean it has no cause. The properties of a triangle indeed have no efficient cause; but things which are susceptible to change must be actuated by a cause distinct from themselves. " Emphatically is this to be noted (Cf. II *Metaph.*): It is just as necessary that there be a reason why things exist as why they are possible (vera). Accordingly, Aristotle was convinced that although some things, as the heavens and the separate substances, existed always, still they had a cause of their existence. From

this it is clear that while Aristotle held an eternal world, he believed God was, for the world itself, the cause of its existence."

4. *Circular Motion can be Endless*

Aristotle himself said (Book Six, L. 13) that motion cannot be endless. Answer: He excepted circular motion. But animals move (locally) after resting, without any extrinsic cause. Answer: There are internal vegetative processes going on all the time; and there is the action of the air and the spheres, which rouse the animal from rest.

5. *Not Everything is Always in Motion*

To say that there is always motion does not mean that everything is always moving. What we do say is that some things are always moving, other never, others alternate between motion and rest. To deny motion altogether would be to destroy Physics, and even mathematics (For the mathematicians use imaginary motion; as 'a moving point makes a line'). Nor does everything always move, as Heraclitus held. "There are indeed tiny and faint motions which can hardly be perceived," as in growth. When falling water wears away a stone, we cannot suppose that in any fraction of the time, however small, some part of the stone is removed. "We must come to *some* quantity removed which is totally removed at once, not part by part. In the removal, therefore, of that total, none of the preceding drops removed *anything;* they merely disposed for removal. The last drop however acts in virtue of them all, by removing that for whose removal the others made the preparation." In this way growth and diminution are intermittent, not *always* going on. The same happens when water freezes. This however does not deny that motion is a continuum; it only means that these particular motions are interrupted by rests. Besides, some alterations, as recovering health, have a term at which they stop. Nor can we say that, e.g., a rock is always changing its quality; nor that it is as truly moving when on the ground as when hurled in the air. Lastly, every natural body has its proper place, at which, when it arrives, it comes to rest.

6. *No Generation or Corruption without Rest*

To say that some things always rest, others always move, is not only to deny the evidence of our senses; it would mean

growth to infinity; it would deny compulsory motion; it would exclude generation and corruption. "For a thing to undergo corruption, it must have first been an ens for a time; for a thing to be generated, it must have been non-ens for a time; but that which is for a time an ens or a non-ens, rests (to speak broadly of rest). If, then, no thing at rest can be moved, it follows that anything which for a time is non-existent, cannot be generated, and anything which is existent for a time, cannot be corrupted. . . . Such doctrine destroys all motion absolutely, because in all motion there is a certain generation and corruption, either simply or secundum quid."

If one say, with Melissus, that motion is only an opinion and an imagination; well, even opinions and imaginations change. "It is evident in itself that some things are in motion." We should not be called on to prove so stubborn a fact.

7. *Mover and Moved are Distinct*

A thing moves *per accidens* if (1) it is a quality in a moving subject, (2) a part of a moving total, or (3) something locally present in a moving body. To move *per se* means that the thing itself is the prime subject of the motion. Of the latter kind are self-movers, as animals, and inanimate things which are moved by something extrinsic. A third division is into *natural* and *compulsory* motion. The motion by which an animal moves its total self is natural, "because it is from the soul, which is the nature and form of the animal." The motion downward is due to the predominant element, and is natural. In violent motion it is evident that what is moved is moved by another. Even in the natural motion of animals the body is moved by the soul (whether the soul be as an oarsman in a boat, or not). But the elements are not self-movers, neither do they stop of themselves, nor move in any direction whatever, as animals do. Besides, elements are continua; but no continuum moves itself; "because the mover and the moved are as agent and patient. Since the agent is contrary to the patient, what is by nature apt (aptum natum) to act must be separate from what is by nature apt to be acted upon. Things which are not merely contiguous, but one and continuous in quantity and form cannot be acted upon by one another. It follows that no continuum moves itself. This is apparent when inanimate things are moved by the animate, as a

stone by the hand. Hence also in animals, which move themselves, there is rather a certain conjunction (colligatio) of parts than perfect continuation; so one part can be moved by another; which is not the case in the heavy and light."

8. *The Elements have a Passive Potency to Natural Motion*

For natural motion it is sufficient that there be in the thing itself a *potency* to the motion, whether the motion be qualitative, quantitative or local. Now, "whatever is in potency is moved naturally by some other thing in act; but nothing is in potency and act together. Hence neither fire nor earth nor anything else is moved by itself but by another. . . . And when they are moved *naturally,* they are moved to their proper actuations, to which they are in potency by their nature." Potency may be to knowledge, to quality, to place. In knowledge the remote potency is ignorance, which is reduced to act by the teacher; "to which act is joined another potency," which is reduced to act by attention (consideratio), when an impediment is removed. As to quality: "A body actually cold is potentially warm, but when it is brought by transmutation to have the form of fire, it is then already fire in act, with the power of burning, unless there be an impediment." Place: "The light is formed from the heavy, as air from water. The water was light in potency, then became light in act, with the power to act, unless something impede it. The light is now related to *place* as potency to act. The actuation of the light, as light, is its being in a certain place, namely above. . . . If it is below, it is detained there by some obstacle. . . . But why do the heavy and light move to their proper places? Because they have a natural aptitude for those regions." That is what light and heavy mean. There is nothing more to say. "Similarly, in quantitative change: by the very fact that there is an addition of quantity to quantity, there immediately follows extension in the expansible body, unless something prevents it." Yet the one who removes the obstacle, moves the other per accidens, as one who demolishes a pillar moves (per accidens) what the pillar supported. Or when a ball is thrown against a wall, "the wall did not give it any impetus for motion, but the thrower did. . . . The wall impeding its further progress in the direction of its impetus, that same impetus remaining, the ball rebounded with a motion in the opposite direction." The

wall moved the ball per accidens. "So the one who demolished the pillar does not give to what it supported the impetus or inclination to fall; it had that from the first generating agent that gave it the form upon which such inclination follows. . . . Though neither the heavy nor the light moves itself, yet their motion is natural, because they have the principle of motion within themselves; not indeed a moving or active principle but a passive one; . . . for a passive suffices. . . . Hence everything that is moved is moved by an intrinsic or extrinsic motor."

9. *There Must be an Unmoved Mover*

The principle that everything that is moved is moved by another, leads to the conclusion that there must be something that is not moved yet moves something else; this mover-not-moved is the *first* of the movers. And a first means a finite series, not an infinite one. And, the other way round, every mover that is *moved* by another, is an instrument; but not everything can be an instrument; at least there must be one mover that moves itself. If you maintain that every mover must also be moved you cannot mean a per-accidens mover, as a musical builder; the "musical" is not *a must* for a builder; there can be non-musical builders. If moving depended on something that could be absent from the mover, then when it was absent, the motion would cease. You must mean that everything, except the last, is an instrument. The last indeed does not move anything else, so it is not an instrument; but prior to that everything both moves and is moved, hence is an instrument; unless there is a first, which moves but is not moved. If there is a moved non-mover (the last), there should be a mover non-moved (the first). So Anaxagoras held that there is an intellect which acts but is not acted upon. Nor is there any escape by supposing that mover and moved have different species of motion. The species are not infinite; "and when all the species are exhausted, there will be a return to the first, for example, local motion," which in the universe is the superior mover. Just as a teacher cannot at once be acquiring the information he is imparting, cannot be moved and moving; "so neither can it be that *every* mover is a moved." Otherwise a builder would not only have to be *built*, but would have to be *being-built* while he was building. The conclusion is

that there must be a first mover, not *moved* by another, but of itself *moving* another.

10. *How Self-Movers Move*

"Mover and moved have a contrariety to one another; but contraries cannot be in the same thing in the same way. Therefore it is not possible that in the same motion the mover and moved be identical. . . . In as much as the moved is still being moved, it is in potency, but the mover is already in act. For nothing in potency is reduced to act except by what is already in act. . . . If therefore the total (self-mover) moved itself totally, the same identical thing would be in potency and act together; but that is impossible. Hence one part of the self-moving is mover, another part is the moved." Nor can we say that two parts reciprocally move and are moved, because that would leave us without an unmoved mover. But if one part moves the other part, without being itself moved, then that part is the immobile mover.

11. *There is a "First" Part in a Concrete Body*

The two parts of the self-moving, as an animal, are the unmoved part and that other part which is immediately moved by the first; because if there are other parts, within or without the self-moving system, they can be omitted and still leave the self-moving intact. Not having yet proved that the prime mover is without quantity, Aristotle, as is his custom, lets his remarks cover movers with quantity and without. Quantitative parts must be in contact, but an incorporeal being can "touch without being touched." And though there is no first in a continuum as such, there is a first part in a concrete body, for there is a minimum in the species; "a natural form requires a determinate quantity."

12. *One Immobile Mover*

If the prime mover is self-moving, at least a *part* of it, which moves the other part, is immobile. In animals that part is the soul. But the soul is *moved* per accidens, i.e. moved by reason of the body's motion. Plato held that animal souls were perpetual; Aristotle, only the intellect is such. But it is the *other* parts that do the moving. Yet, whether the souls are perishable

or not, " there is a prime mover, perpetual and altogether immobile." There is nothing to show that this immobile must have magnitude; and if it have no magnitude it cannot be generated or corrupted. If nevertheless it sometimes exists and sometimes does not, it cannot be the cause of the perpetuity of generation and corruption. If there are many of these supposed first movers, they must all exist together, if they are to be the cause of that perpetuity; and in that case are equivalent to one mover; and if such movers go out of existence and come into existence, " there must be something above them all which contains them all in its power, . . . and this mover, whether one or multiple, must be perpetual. . . . But one is sufficient, therefore many are not to be postulated." And since motion in the world is *continuous* there cannot be a succession of movers; there must be but one mover for the one world.

13. *The Prime Mobile has Perpetual Motion*

Since motion in the universe is unceasing, the prime mover must be perpetual. Objection: " He had said that any mover which is moved per accidens does not move with perpetual motion. But there seems to be an instance to the contrary; because, according to his doctrine, the motions of the lower spheres—the Sun, the Moon and the planets—are perpetual. And yet their movers, according to what he said above, are moved per accidens. He said that the soul of an animal is moved per accidens because the animal's body is moved by some extrinsic agent which is not the soul. In the same way it appears that the sun's sphere, carried as it is from east to west by the motion of the outer sphere, is moved by a motion other than its own. That westward motion is not from its own mover; for that mover [which accounts for the Sun's apparent motion among the stars] moves it in the opposite direction, from west to east." Answer: To be moved per accidens has two meanings: (1) A thing may be moving in one direction and yet be carried in another direction by something else, as a man walking on board a moving boat. Thus " the motors of the spheres are moved by many motions—their own and that of the heavens above." (2) A thing may undergo change simply because something else changes; as the souls of animals perish because the body corrupts. " The motors of the upper spheres, on the contrary, are not constituted in their

existence (esse) by their union with bodies, and their union with them is unalterable."

Aristotle did not prove the perpetual activity of the prime mover (as Averroes said; Cf. VIII, L. 1) from the perpetual motion of the first sphere, but from the fact that there always is motion in the universe as a whole. He proves the perpetual motion of the first sphere from the fact of successive generations and corruptions, which, strictly taken, are instantaneous (timeless) changes—" mutationes non temporales." These cannot be due *immediately* to the ever-acting prime mover, for then they would be continuous processes. The prime mover, because it is immobile, cannot change its disposition toward the moved; but the first mobile, because it is mobile, can give rise to a variety of motions—among them, continuous alteration which results in instantaneous generation. Yet the motion of the prime mobile, on Aristotle's own premises, can be perpetual, after it has started, without having been from eternity.

14. *There is Always Local Motion*

" It is necessary that local motion be the first motion, primus inter omnes." Augmentation is nutrition, and that requires qualitative change, alteration. Alteration requires that the agent be moved into proximity to the patient. Hence local motion is always required; and since there is always change going on, there is always local motion. Besides, augmentation and diminution are motion to a larger and to a smaller place. So, although local motion can be without the others, the others cannot be without *it*. Since all the others depend on it, local motion must be the first. Again, the most perfect animals have local motion; hence such motion is the most perfect. The same is seen from the fact that local motion alone does not mean any loss to the subject, as alteration and quantitative changes do; and from the fact that local motion is most proper to the prime mobile, the heavens, the most perfect of bodies.

15. *There is Always a Rest Between Motions*

" Whatever is moved toward a contrary, rested for a while (aliquando) with the rest opposite to that motion. Therefore no motion to which there is a contrary can be continuous and perpetual." If the motion be between " contradictories " as in gen-

eration, it is sufficient that between two successive generations there be a corruption. These motions (alterations) are opposed to one another. "One contrary motion is opposed in some way both to the contrary motion and to the rest [away from which it is moving]; to the motion by direct contrariety; to the rest rather by privative opposition, which however has something of contrariety, in that the rest is the opposite of the end and completion of the contrary motion." But between opposite motions there must be a rest, for if the motion did not stop for a time at the term, the process of arriving at it would be futile.

16. *Reversed Motion is Discontinuous*

Local motion is either straight, curved, or a combination of these two. The straight is along three directions and has six termini, three pairs of opposites. That such opposites are contraries is obvious from the fact that a thing cannot move toward both at once. Circular motion can also be reversed. "Whether the reversion occurs in a straight line or in a curved line, there must be an interval of rest. . . . Because any indicated intermediate point, between the termini of a line over which anything moves, is in potency and not in act unless a division of the motion occurs there; that is, unless the moving object stops at that point, and begins again to move away from the point. Thus the intermediate point becomes actually a beginning and an end: the beginning of what follows, and the end of the first motion, which was terminated there by rest. . . . But to arrive at and to depart from are contraries, and contraries cannot be in the same instant. . . . From this it is clear that reversed motion cannot be continuous, but an intermediate rest intervenes. . . . In circular motion however the mobile does not use any point as an actual beginning or end. Therefore circular motion, so long as it is not reversed, can be continuous."

17. *Zeno Refuted by Continuity of Time*

Zeno: Anything moving cannot be approaching a point and receding from it at the same time; it must recede *after* it has approached. Answer: You cannot speak of approaching and receding, unless the point is actuated by a stop; but a stop breaks the continuity of the motion. Otherwise you must say it was there for an indivisible instant, or *no* time; it never was

precisely *there*. So you cannot speak of approaching and receding in the course of continuous motion. "But in reversed motion you must so speak. For if the mobile is carried to the point D, and reflected back, it is obvious that it uses the extremity D both as a beginning and an end, uses the same point twice; hence it must rest there. . . . In reversed motion it is necessary to come to an end, which end is actual, and not only in potency." But straight motion cannot go on without end, it must be reversed; so it cannot always be continuous.

Zeno's difficulty about crossing the half, and the half of that, and so on, is now answered on the score of *time*. You cannot make time discrete. To divide a continuum is to destroy the continuity; and that, in time, would mean moments when time rested. The points in time are potential, not actual. Also, while a thing is *being* generated, it is not yet generated. Only at the terminus can it be said to be this specific *ens;* during the time preceding that, it was not such an *ens*. So it cannot be said to be at once ens and non-ens. But the terminus of the time is not a part of the time, and so adds nothing to the preceding time. And it is an actual terminus of the *process*, of generation, not an actual point of the time itself.

18. *Though Motion Stop, Time Does Not*

If reversed rectilinear motion were continuous, say from A to C and back, "then, while it was on the way *from* A it would be on the way *to* A." And since it did not stop at C, it never was *in* C; and the return motion would be *from* a term *in* which it never was. "The mobile must rest in the point of reflection, i.e., in C." Besides, "of two things privatively opposed, when one is *not* in the subject, the other *is* in it; but rest is privatively opposed to motion. . . . Now, rest in C is opposed (not to the motion toward C but) to the motion *away* from C." Therefore the motion away presupposes rest in C. The same is true of alteration. "While white is being generated, non-white is being destroyed, and conversely." But if there is no rest "aliquo tempore" between the two processes, it is all one process, and the generation of white is the same process as its corruption. In strict generation the terms are opposed, not as mere contraries, but as "contradictories"; so there the argument is still more forceful. "And what is said of this case is extended to all

motions, because in every motion there is a certain generation and corruption." Nor does the continuity of time guarantee the continuity of motion, because, as was said in Book Five, in a continuum, an indicated (potential) point in time does not sever the continuum; it is one point only, not two termini "simul." The same is true of the advancing indivisible now between the past and the future, as of any moving point. But the termini of contraries cannot even be together. Therefore reflex motion cannot be a continuum.

19. *Circular Motion Alone is Perfect*

In circular motion the parts of the path are always traversed in the same order, and the same end of the moving body is always forward; neither of which is true of reversed motion. For the same reason the motion over one semicircumference is not opposite to that over the other. "It is of the nature of opposites that they have reference to the same thing." So motion along the diameter and back passes through the same intermediate position; motion around the circle does not. "And only in the circle is the end joined to the beginning; and so only circular motion is perfect. For a thing is perfected by the fact that it attains to its source." In alteration and augmentation or diminution, when the mobile returns to its former condition, the same intermediate quality and quantity must be passed through. "The same is true in generation and corruption. For if from fire, air is formed; and again from air, fire is formed, the intermediate dispositions must be twice passed. A medium can be supposed in generation and corruption if it be understood in connection with the transmutation of the dispositions. So it is in all reversed motion, whether the media be many or few whether positive, as gray between black and white, or indifferent as between good and bad." Rectilinear motion cannot continue infinitely, but must be reflected, and so multiplied. But motion which stops is "imperfect and corrupted. Imperfect because it is possible to add to it; corrupted, because, when it has come to the terminus of the magnitude, the motion ceases." Circular motion has neither of these shortcomings. But to the imperfect, the perfect is prior; to the corruptible, the incorruptible is prior—in nature, in reason, in time. The motion of the first mobile is one and perpetual, and this can only be circular motion.

20. *Circular Motion is the Measure of All Others*

In rectilinear motion there are termini actu, in circular motion there is no terminus actu, nor is there recession from or approach to the center; " but motion that is never at the beginning, never at the end, is continuous motion."

" As circular motion is the first of motions, so it is the measure of motions. For all things are measured by the first of their kind (Cf. *Metaph.*, X) . . . . And only circular motion can be uniform." Natural motions increase their velocity as they approach their term, violent motions decrease. Circular motion has no term, so it alone is uniform.

That local motion is the first of motions, all the ancient philosophers and the common people agree. We have seen that there is a perpetual principle of motion, the immobile *mover;* and we have seen which *motion* is first and perpetual.

21. *The Prime Mover is Incorporeal*

A finite mover cannot take infinite time to move a finite mobile, " est impossible aliquod finitum secundum potentiam movere per tempus infinitum." Proof: (Suppose, e.g., a boat moving its cargo, which extends the full length of the boat.) Let A be the mover; B, the moved; C, the time. And let C be infinite. Now D, a fraction of A, moves E, a fraction of B, past a given point in *less* time than A moves B past the point. Call this lesser time Z. Z, being less than C, is finite. Multiply D until the total equals A; and simultaneously you multiply E until the total equals B. But a multiple of a finite is finite. So the time in which A moves B is finite; it cannot take infinite time to move B; that is, move it completely (adequately) past a point. However the heavens are moved in complete rotation in finite time; so the mover may be finite.

Again, if the mover is *infinite* in magnitude, it must have infinite power; and such power would move the heavens around in no time, " in non tempore." Still a *finite* power could not continue to move the heavens *sempiternally.* [Aristotle here, as elsewhere, supposes the motion to be overcoming resistance.] Hence the prime mover is neither finite in magnitude nor infinite in magnitude. The solution is that the prime mover has *no* magnitude. " Every power which is not in a magnitude moves by

intellect. It is thus the Philosopher proves the heavens are moved by their power (*Metaph.*, XI) . . . . There is this difference between an agent acting through intellect and a material agent, that the action of the material agent is proportioned to the nature of the *agent* . . . whereas the action of an agent through intellect is not proportioned to its own nature, but proportioned to the *form apprehended.* A builder does not build as much as he can, but as much as the plan calls for." So, too, the mover of the world proportions his power to the nature of the world.

Averroes says that the heavens depend on that power for their motion but not for their existence; "because forsooth the celestial body is not composed of matter and form. . . . But that is altogether impossible. For it is evident that the celestial body is something actual, otherwise it would not be being moved. (Cf. Book Six.) And everything that is actual must either be a subsistent form, as the separate substances, or have its form in another; which other is to the form as matter, and as potency to act. But the celestial body is not a subsistent form. . . . It is therefore composed of matter and form, and of potency and act. Consequently there is in it, in some way, a potency to non-existence." Aristotle himself (*De Coelo* I) says that the heavens are in potency to continued *existence.*

From the divisibility of magnitude it is proved that an infinite magnitude must have infinite power; which, being a material agent, would impart infinite velocity to the universe. Hence the power that moves the world cannot be a divisible thing; yet it must be inexhaustible, infinite. It must therefore be a spiritual agent.

22. *Unceasing Motion requires a Constant Mover*

The thrower of a projectile, as a stone, cannot simply move the air together with the stone; because then the air would stop, as well as the stone, the moment the thrower stopped. There must be imparted to the stone a certain *momentum,* because at the end of its flight it causes motion in what it strikes, just as the thrower caused the stone itself to move. But thus, without a constant mover, the motion soon ceases.

23. *The Prime Mover is Immobile, One, Infinite*

Motion is continuous in the universe. But continuous motion is one. It cannot be one if there are successive movers or suc-

cessive mobiles. A moved mover is by its own mover necessitated to move other things and to be altered in its disposition. But the unmoved mover is under no necessity, and can produce motion without any change in itself. Hence it can produce motion perpetually and without variation, uniformly. "Thus the celestial body is moved locally by the unmoved mover and suffers no variation in that motion. If the mover changed, its disposition toward the moved would not remain the same, and the motion of the heavens would not be uniform."

Is the mover in the center of the universe or in the circumference? "The nearer anything is to the mover, the faster it is moved, as it receives more of the force of the mover. . . . Therefore the mover is in the circumference, not in the center." But there is a difficulty here. The outer heavens move from east to west. But all the heavenly bodies have likewise another motion—from west to east. Moreover, these retrograde motions are the more rapid the nearer the center. For these west-to-east motions, "astronomers assign to the motion of the moon one month; to the Sun, Mercury and Venus, one year; to Mars two years; to Jupiter, twelve; to Saturn, thirty; to the fixed stars, thirty-six thousand years." Nevertheless, the whole heavens revolve every day; so, regardless of these retrograde motions, the farther from the center the greater is the speed of motion.

But how can an indivisible mover be in any one part more than in another? Not indeed by the greater intensity of its substance, "per determinationem suae substantiae"; but by its effect, which is primarily in the outer heavens, since that sphere moves the rest. In the same way it can be said that its force is from the east. And as a revolving sphere is said to move and not to move, so the circumference is said to be the principle of motion, the center to be the principle of immobility.

Perfectly uniform motion can come from only one mover; and the uniformity is due to the unchanging disposition of the mover; whereas the sempiternity of it is due to infinite power. Later (*Metaph.*, XI) Aristotle had a difficulty about the *moved* movers of the reagent spheres, and said that they are many and immobile. But he has here proved his principle thesis, that the *prime mover* is immobile, immaterial, one, infinite. "Thus the Philosopher brings to a close his universal treatise on nature, letting it culminate in the Prime Source of all nature, who is above all God blessed forever. Amen."

VI

NOTE

Aristotle's Position on the Sempiternity of the World

A study of Aristotle's position should begin with two passages in the *Topica* (I, 11, 104^b, 15; and 14, 105^b, 25) where he sets down as debatable the question: "Whether the world is eternal?" And the precise question there is whether the world could have been *motionless* from eternity before being set in motion. Anaxagoras had held "that all things were together and at rest for an infinite period of time, and that then Mind introduced motion" (Aristotle, *Physics*, VIII, 1, 250^b, 25). After a long discussion (*ibid.*) Aristotle decides against Anaxagoras. In this Aristotle is accused by St. Thomas of using bad logic (*Phys.* VIII, L. 2), but it is not to be thought that St. Thomas is defending the thesis that the world was ever motionless de facto. He merely says that Aristotle's argument does not prove it to be impossible.

Nor does St. Thomas consider that Aristotle himself took the sempiternal motion of the world as something apodictic.

> The arguments which Aristotle gives are not direct but indirect; they merely demolish the hypotheses offered by previous thinkers who contended that the world began in certain specified ways, which were in truth impossible. That his arguments were of this kind is clear on three counts (Cf. *Physics*, VIII; *De Coelo*, I). 1. He cites the opinions of others, as Anaxagoras, Empedocles, Plato; then argues against them. 2. Whenever he speaks of this matter he invokes the authority of his predecessors, which is not the procedure of deductive reasoning, but of inductive or 'topical' argument. 3. He expressly states in *Topica* I, that there are certain debatable questions for which we have no definitive solution, as 'whether the world is eternal' (*S.T.*, I, 46, a. 1, c.).

We can be quite sure that St. Thomas did not entertain the opinion that God, in His infinite wisdom, would create the world and leave it motionless and idle for an eternity, or for even a finite time. Hence, on this point of fact, he was in agreement with Aristotle, but not for the reason Aristotle gave. Also, on

the authority of Revelation, he held that not only motion but the very substance of the world had a *temporal* beginning.

The only question left is: *Could* a created world exist from eternity? And here we are to understand not a motionless world but a sempiternally changing one. As is well known, St. Thomas assumed a neutral attitude on this question. He conceded that he had no positive proof to show that such a world is possible, or that it is impossible. He defended the possibility as something that was only negatively probable; that is, he essayed to answer all the objections which had, up to his time, been brought forward against such a possibility (Cf. C.G., II, 38; *ibid.*, 81; *S.T.*, I, 7, a. 3, ad 4; and "De Aeternitate Mundi"). With all this as a context, we can see how St. Thomas can sincerely declare, "It is clear that while Aristotle held an eternal world, he believed that God was, for the world itself, the cause of its existence" (*Physics*, VIII, L. 3). Since Aristotle had decided (illogically) that there must have been motion from eternity, it followed that the world must have existed from eternity. But that did not preclude its being dependent, produced, created (Cf. St. Thomas, *Physics*, VIII, L. 1). On the other hand, outright creation in time, as distinct from starting motion in a motionless world, does not suppose a previously existing subject in which motion was to be produced; therefore creation as such is not a case of *motus*, and hence is not even exposed to Aristotle's criticism, based as that criticism was on the starting of motion by natural causality in a previously existing but motionless world (Cf. St. Thomas, *Physics*, VIII, L. 2).

VII

ANALYSIS OF THE PHYSICS

A formulation of the principal propositions or "theses" established (Arabic numbers refer to the various Lectiones). Offered as more explicit than the traditional Latin headings.

BOOK ONE

(1) Physics is the inductive study of the material world and its explanation in terms of the four causes and the constituent elements. (2) Since nature is the source of activity and change, Physics is the Philosophy of Nature. (3) But we cannot accept extreme Monism, nor (4) extreme Pluralism, nor (5) a world infinite in extent. (6) We must accept not only substance, but (7) also accidents as real beings.

(8) With the Physicists, we accept elements, but we deny that the only change in the world is rarefaction and condensation. (9) Instead, we recognize that a thing can be actually one kind of being, and potentially other kinds. This however does not exclude atoms, which we accept as "minima naturalia." An element can be resolved only into atoms which are all of the same kind; a compound is resolved into components of different kinds, namely into the elements. Elements can combine into a compound which is different in kind from any and all of the elements. Yet this does not require an infinite number of elements, nor of atoms.

(10) All agree that anything which undergoes change comes from a contrary, it *becomes* what it *was not.* (11) But, since substance is not a contrary, substance must be the ultimate subject of change. Yet the four elements are contraries, therefore there must be something common to them all, (12) in both substantial and accidental change. (13) Change involves possession (form) and privation; (14) which latter was overlooked by the Physicists. (15) Every category has act (form) and privation (appetite).

Book Two

(1) Natural objects are: animals, plants, elements. Each of these has a nature which responds to influences that start and terminate its movements. (2) Nature is more in the form than in the matter, but motion proper is due to matter. (3) Physics does not deal with imaginable, "intelligible," matter, but with perceptible matter. (4) Physics considers forms in matter; to consider forms without matter is in the province of metaphysics.

(5) Causes considered are: efficient, final, material (the elements), and formal. (6) The nearer to the first cause, the more general a cause is; the farther away, the more specific. That there be *some* efficient cause is per se necessary; a particular individual, as Polycletus, is a "per accidens" cause.

(7) Chance events are not to be denominated such with respect to the supreme cause, because He foresees; they have the character of chance only to the inferior causes, as foreign to their proper ends. (8) Every agent has an end of its own; chance is extrinsic to that end. (9) Chance events are per accidens, that is, concomitant to the per se end of the natural agent. (10) "Fortune" is said of rational beings, "chance" of irrational. In corporeal things we must seek for the explanation of chance in the material, efficient and final causes.

(11) In physics we are primarily concerned with matter and the mover. Motion is always towards a form, which embodies an end. (12) Final cause is necessary for the explanation of physical facts, because natural objects have an evident aptitude for certain purposes; the recognition of this makes the study of nature rational. (13) Since the uniformity of natural events excludes chance, there must be purpose. (14) If there were no ends there would be no such thing as nature, nor anything unnatural. We learn the ends from the performances of physical things, though they have no intelligence of their own. (15) In any ordered process the first thing determined upon is the end, which calls for a certain form or nature in the thing which is to attain that end, as in the building of a house. And form calls for a certain aptitude in the matter. Thus ends dominate the physical world.

BOOK THREE

(1) Since both motion and relation require a subject, but the subject of a relation may remain unchanged while the relation is changed, it follows that motion is not itself a relation. Motion proper occurs in quantity, quality, place; it is reduced to the category relation by the patient's need of an agent. (2) Motion is the actuation of a potency in the process of actuation. (3) Motion is therefore essentially an unfinished actuation, a mixture of potency and act. (4) Motion is only *in* the patient, though it is the effect *of* the agent. (5) Agent and patient are, of themselves, in the category substance.

(6) The Pythagoreans, seeing that an ultimate terminus made a thing finite, accepted the infinite divisibility of the continuum, and postulated the boundless extent of matter. (7) The infinites to be considered are: time; extensive continuum; the succession of natural events; the magnitude of the universe; imaginary space. (8) None of the elements can be infinite in extent without one element compenetrating another, which is impossible. (9) Besides, if the whole world were infinite in extent there would be no center of gravitation, hence no gravitation; but there is gravitation. (10) The divisibility of the continuum is an inexhaustible passive potency, hence an "infinite" of imperfection. (11) Actual division terminates a stretch of the continuum, but between the termini there is only a formless indefinite or "infinite." (12) Whatever be said of the mathematical division and addition, in an actually existing world (which must be of finite dimensions) there cannot be an actually infinite number of actual parts or minimal particles. Nor is there in prime matter a potency to any extension whatever. (13) World processes can continue endlessly without an infinite supply of material to be used up, because generation and corruption are reciprocal, and so can be endlessly successive in the same matter. As for imaginary space being "infinite" we need only remark that the imagination does not require an existing object corresponding to it. Nor can time and motion be infinite in act, because they are essentially in potency to further actuation.

BOOK FOUR

(1) Place is an actual receptacle only when the placed body is there. (2) Place does not compenetrate the placed body. (3)

Although form limits the matter to the species, and matter limits the form to the individual, these are intrinsic principles, whereas place is extrinsic and limits the body by simply enclosing it. (4) To be in a place means to be inside another body; all other meanings of " in " are derived from this one. (5) Bodies come and go but the place remains, and it is the place strictly only if there is immediate contact with the enclosed body. (6) Hence place is successfully defined as the inner surface of an immobile body surrounding and in immediate contact with the placed body.

(7) The revolving heavens are said to move because each sector succeeds to the place where another sector was. (8) The boundary itself, having no thickness, is not in a place. " Natural " place attracts things, as the elements, which have an affinity for that place. (9) Expansion and contraction can occur without there being vacua around or within the body. (10) Bodies can move about without needing vacua in front of them, because they can compress one another as they move.

(11) A body in motion in a vacuum would never change its direction nor come to rest. (12) In a vacuum all bodies would fall with equal velocity. The factors determining velocity are: inertia, force, medium. (13) Bodies do not compenetrate one another. (14) Nor do they need internal vacua in order to be compressed.

(15) About time, the great difficulty is that the past and the future are non-existent and the present has no duration. We answer that in local motion the terminus " from which " and the terminus " to which " do exist and remain while the transit between them is going on; from these facts we derive the concept of time. (16) Not any and every motion provides us with the concept of time as a measure. (17) Not the mere motion of the heavens but the uniformity of that motion, together with the fact that it controls all other motions, gives us the concept of time as a measure. The succession of ordinal numbers is also derived from motion, since the assignable parts of motion have the character of " before and after." Time is not an actuation, as motion is, but an extrinsic measure and ordinal numberer of cosmic events. (18) As in the motion of transfer a body remains the same, so the present now (somewhat like eternity) does not change, though the past and future of its path do change. (19) But for time to be a measure two nows must be selected. And

when the time interval is unknown it can be measured by a known motion. (20) A stretch of time measures, besides motions, also rest and the unchanging duration of specific substance. (21) A " then " can be the beginning of a stretch; it does not need, a Aristotle mistakenly held, to be the terminus of a previous stretch. (22) Time is not the cause of decay, but we often ascribe decay to " time " because the real agencies or deficiencies responsible for decay are hidden from us. (23) Granted that time is the uniformity of the heavens' motion, nevertheless that uniformity must be recognized by the mind and the unit revolution noted.

Book Five

(1) A thing is in motion " per accidens " when it is in something else that is being moved; the thing which is itself being moved is in motion " per se." A self-mover, as an animal, is moved " per partes " when a stationary part moves other parts. (2) Generation is from negative (non-ens) to positive (ens); corruption is from positive to negative. Motion proper is between two positive contraries. (3) Motion takes place between the termini; the termini are non-motion. (4) Motion per se occurs only in quantity, quality and place, because only these categories have positive contraries. (5) Motion is not discrete nor contiguous succession, it is continuous. (6) In any genus (category) the species of motion is determined by the terminus ad quem and the medium. A motion is individual if there be no interruption, no change of genus or species, the same immediate subject enduring throughout. (7) Variation of velocity does not interrupt the motion, but uniform motion has more unity than irregular motion; straight and circular motion have more unity than angular. (8) Generation and corruption " secundum quid " (accidental mutation) are opposite to one another because they are an approach to and a retreat from a terminus, i.e. the ultimate disposition for a substantial form. Qualities contrary to one another can also be considered as opposites of the medium quality. (9) Not alone are motions opposites, but rest in one extreme is opposed to rest in the other extreme. Also rest is opposed to the motion away from it, not however to the motion toward it, since it is the fulfilment and completion of that motion. Substantial form is not a rest, since rest implies something grad-

ually attained; it is a non-changing nature. Substantial form's opposite is the privation of that form—which however is not totally negative, since the privation is in a subject, prime matter. (10) Violent, or compulsory, motion is produced by an external principle, and when it works against the natural motion it does not generate rest (which is a bonum to the subject); it merely corrupts the motion, depriving the subject of its natural motion. If it is in keeping with the natural tendency or potency of the subject, compulsory motion may produce (not rest) but a new nature, as in spontaneous generation (by the action of the sun), or produce a new or an increased motion.

Book Six

(1) A point added to a line is not a new point unless it is the beginning of another line; in which case the two points are "simul," not "unum." (2) If extent were composed of indivisibles, then motion would be composed of a series of rests. (3) Motion continues at any velocity, however low, and terminates only in non-motion for a finite interval of time. (4) Motion does not actuate any point unless it stops there; hence Zeno's difficulties, which require points to be actuated, are based on a false supposition. (5) A time interval is a stretch between two nows, but always in the same direction; motion, on the contrary, can reverse its direction. Only those changes which are divisible into successive stages are motion; hence substantial changes are not motion. (6) In measuring local motion by the time, we require the whole body to pass from a given position to an adequately distinct one; in measuring by the space, it is only necessary to observe successive parts pass a fixed mark. (7) In local motion both termini remain extant; in alteration neither term is extant during the change. Qualities which in the pure state have no various degress, as perfect white, may be gradually acquired, participated, in varying degrees by the changing subject. (8) "Non-ens" means the privation of substantial form, "ens" means its possession; both are termini, non-motion; but between them occurs the motion of alteration. This motion has two termini "to which": the proper quality for the new substantial form; and the new form itself. (9) Any body in un-

reversed motion will traverse a finite path in finite time, whether the body or the path be considered in motion. (10) Deceleration is as truly continuous as in uniform motion, and there is no discontinuity except by total rest for a finite interval. (11) Zeno's difficulties suppose that there are actual points in time, whereas there are none. Nor is there any contradiction in the same motion having different velocities when different referents are chosen. (12) It is fallacious to speak of a mathematical point moving, because there is no immediate next point-position at which it could stop after having moved; the only way it can move is per accidens, i.e., when the extended body in which the point is, moves. (13) In natural motion the term or end is determined by nature; in compulsory motion not so. The motion of the heavens is, because circular, unterminated locally (but its purpose is the perpetuation of life on earth).

Book Seven

(1) The principle, " Everything which is being moved is being moved by another " holds even for spiritual beings, which however can acquire perfections without losing anything. (2) For any series of things in simultaneous motion there must be an original or first not moved by another. (3) All motion, i.e. acceleration, can be reduced to attraction and repulsion. (4) There is no action at a distance, not even in sensation. (5) Forms, accidental and substantial, are not processes, and so do not themselves undergo change. (6) Habits which are the proper equipment of a nature are not gradually generated, yet they depend on conditions extrinsic to them for greater freedom of exercise.

(7) All motions may be measured univocally by the time, but extents are measured univocally only by an extent of the same species (i.e. of the same termini and medium); if the species differ, as rare, dense, curved, etc., the measurement is analogous. (8) Since only species, not genus, is the determining form, qualities to be compared, measured, must be of the same species. However a quality may spread to a greater or less extent through an area, and that is quantitative measurement. (9) The velocity of a body being moved is determined by the resistance and the force exerted, provided the mover itself has not a fixed velocity of its own.

BOOK EIGHT

(1) Even motion from eternity must have its source in another, a superior mover. (2) Creation, since it is not generation, does not require a pre-existing subject. Everything which is being moved, since it has passive potency, requires a cause already in act. (3) Things being changed, as the world, require a cause distinct from themselves. (4) Circular motion, since it can continue endlessly without reversing, can be sempiternal. (5) Although there is always motion in the universe, some things can be at rest. (6) Generation secundum quid (qualitative alteration) is separated from a subsequent corruption by a period of rest in the form acquired and the privation suffered. (7) The prime (per se) subject of motion, as the part being moved, is distinct from the mover. (8) The actuation of a "perfect" subject (i.e. one in the ultimate disposition, where the acquisition of the new form does not involve the loss or corruption of anything) is reduced to act by the simple removal of obstacles. (9) In every case where motion is being produced there must be a mover-not-moved, the first. (10) In "self-movers" one part is a non-moved mover of the other parts. (11) In a concrete body, though not in an abstract continuum, there can be a first part which moves the others. (12) Since the motion of the heavens in continuous there must be a single perpetual mover. (13) Although the Prime Mover does not change its disposition toward the universe, the prime mobile (moved mover) does, as is evident from the succession of generation and corruption. Other motions cannot occur without local motion but *it* can occur without the others. Local motion as such does not entail any loss to the subject, hence it is "perfect." (15) If motion did not cease in its term for an interval of rest, the motion would be purposeless (i.e. if the motion is perfective of the thing being moved). (16) Sublunary motions, being interrupted by rests, are discontinuous; only the motion of the heavens, since it is circular, can be uninterrupted. (17) Zeno's contention that all motion is in itself discrete is based on the assumption that the points in time are actual, whereas there are only potential points in time, as in the uninterrupted motion of the heavens. (18) Although reversed motions be discrete, time continues on uninterruptedly. (19) Circular motion is "perfect" because it returns to its beginning

without reversing, and because, being forever continuous, it is not multiple but one. (20) Since the revolution of the heavens is uniform, perpetual, and the efficient cause of all other motions, it is the measure of all the others. (21) The mover of the first heavens cannot be a finite body, and therefore of finite power, because such a body could not produce motion forever; it cannot be an infinite body, with infinite power, because such a body would move the finite heavens with infinite velocity; therefore it must not be a body at all, it must be incorporeal. This last will serve, because an incorporeal agent ("intellect") produces motion not according to its own nature but according to the nature of the object to be moved. (22) Where there is resistance, the body's momentum is insufficient to continue the motion indefinitely without a constantly acting mover. (23) Despite the retrograde motions of the lower heavens, the outer heavens have a motion that is uniform, therefore their Prime Mover is incorporeal and unchanging in disposition; a motion which is continuous, therefore the Mover is one; a motion which is sempiternal, therefore the Prime Mover is infinite.

VIII

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I, 18, 3, c. Degrees of life
I, 42, 2, ad 2. Creation not change.
I, 53, 1, ad 2. Angels not subjects of motion.
I, 53, 2, c. In motion, intermediate positions are only potential.
I, 53, 3, ad 3. How angels move bodies.
I, 62, 2, c. Natural motions.
I, 73, 2, c. Rest as cessation of activity.
I, 78, 3, c. " Spiritual " and " natural " alteration.
I, 78, 4, c. Animal instincts.
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I, 103, 3, ad 1. Difference in mobiles.
I, 103, 5, ad 2. Chance.
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I–II, 6, 4, ad 2. Natural motion is suitable to the matter.
I–II, 15, 2, c. Appetitive motions.
I–II, 16, 2, ad 1. Use and fruition.
I–II, 17, 9, ad 2. Vital motions.
I–II, 26, 2, c. Action and passion.
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I–II, 31, 3, ad 2. Fruition as rest.
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I–II, 37, 4, ad 1. " Spiritual " alteration.
I–II, 113, 7, c. Matter's disposition for change.

II–II, 44, 5, c. The heart a principle of movement.
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I, 13. Proof of the Motor Immobilis.
I, 42, (4, 5). Only one Prime Mover.
II, 17. Creation not motion or change.
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II, 43. Action of celestial on terrestrial bodies.
II, 90 (3, 8, 11). How the "intelligence" effects changes in the world.
II, 92. Number of movers for the spheres.
III, 6 (ad fin.). Privation intended per accidens.
III, 22. Celestial movers intend good of man.
III, 23 (5, 6, 10). It is for man's sake that the heavens do not come to rest.
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III, 87. Astrology.
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I, 53, 3, c. Angelic journey takes place in time.
I–II, 113, 7, ad 5. A state of the soul may have a first instant.

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I, 15 (3, 6). A beginning of world-motion is possible.
I, 55 (ad fin.). Time derives from motion.
II, 35 (6). Why world was created at certain moment? meaningless.

II, 38 (5, 11, 12). Defense of possibility of creation from eternity.
III, 84 (ad med.). Intellect can abstract from time.

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I, 52, 1, ad 2. How an angel may be in a place.
I, 52, 2, c. "Circumscriptive," "definitive," "ubique."
I, 102, ad 1. Location of Paradise.
III, 53, 3, ad 3. How Person of Christ is in a place.
III, 76, 5, ad 1. Presence in the Sacrament.

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II, 35 (6). Why world was created in this place? meaningless.
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The Infinite

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I, 25, 2, ad 1. "Unterminated" matter.
I, 46, 2, ad 8. Possibility of creature existing from eternity.
I, 54, 2, c. Infinitum simpliciter, secundum quid.
I, 75, 5, ad 1. No infinite passive potency for all acts.
I, 86, 2, ad 1. Infinitum materiale, formale.
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I, 26. Existence limited by subject.
I, 43. Infinitum privative, negative.
I, 69 (4, 5, 7, 18). God's infinite knowledge.

II, 26 (3). God's intellect transcends all finite things.
II, 52 (4). Only one infinite Existent.
II, 59 (6). Unlimited scope of created intellect.
II, 81 (4). Sempiternity of the world.
III, 54 (14). Only the infinitum privative is "unknown."

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I–II, 18, 8, ad 1. Total and partial privation.
I–II, 36, 1, c. Displeasure as a privation.
I–II, 73, 2, c. Privation has degrees.
I–II, 82, 4, c. Original sin a privation.
I–II, 86, 1, ad 3. Actual sin a privation.

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I, 37 (4). Evil supposes passive potency to privation.
I, 39 (6). Privation supposes subject.
I, 71 (4, 5, 6, 10, 12). Form and privation are opposites.
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II, 41 (10). Privation has no efficient cause per se.
III, 6 (1-4). Nature does not intend privation secundum se.

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I, 33, 2, ad 4. Generation denominated from its term.
I, 42, 2, c. Successive generation is motion.
I, 45, 3, c. Spontaneous generation.
I, 53, 3, c. Instantaneous generation.
I, 66, 2, c. Nature of heavenly bodies.
I, 69, 2, ad 3. Occult generation.
I, 75, 6, c. Non-subsistent forms generated per accidens.
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I, 91, 2, ad 2. Influence of sun in generation.

I, 92, 1, c. "Equivocal" generation.
I, 118, 2, ad 2. Progressive generation by hierarchy of forms.
I–II, 22, 2, c. Generation may involve loss or only gain.
I–II, 113, 6, ad 2. Generation and corruption one process.
II–II, 162, 7, ad 3. First in generation last in corruption.
III, 28, 1, ad 4. Miraculous generation.
III, 77, 5, c. Generation in the destruction of the Sacred Species.

CONTRA GENTES

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II, 42 (9). Spiritual substances, heavens, prime matter are ingenerable.
II, 55 (2-9). Generation "simpliciter" and "secundum quid."
II, 89 (3, 5). No hierarchy among elements.
III, 66 (4). Agent ceases acting at advent of form.
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III, 104 (10, 12, 13). Life from non-life artificially (?).

CORRUPTION

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I–II, 85, 6, c. Death due to corruptible matter.

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I, 79 (3, 7, 9). Causes of corruption.
III, 83 (ad fin.). The individual ceases in corruption.
IV, 81 (1-3). In the resurrection the same man returns.

ELEMENTS

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I, 74, 1, ad 2. Fire and air are nobler elements.
I, 91, 1, c. The elements in the human body.
I, 91, 3, ad 2. Lower elements less active in man.

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IV, 30 (4). Essential and elemental principles in man.
IV, 63 (6). Elements not prime matter.
IV, 87 (2). Contrariety of elements overcome by soul.

VACUUM

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I, 46, 1, ad 4. Empty space antecedent to the world.

IX

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